Features of iPad Language Applications for Speech-Language Therapy with Children

Nikki Heyman

A dissertation submitted to the Faculty of Humanities, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree Master in Speech-Language Pathology.

DECLARATION

I, Nikki Heyman, hereby declare that this dissertation is my own original work. It is being submitted for the degree of Masters in Speech-Language Pathology in the discipline of Speech Pathology and Audiology, in the School of Human and Community Development, University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination at this, or any other university.

Signed:

Date: March 2017

Abstract

Background: Speech-Language Pathologists (SLPs) worldwide are using apps in their interventions. Despite this growing trend, there is limited literature on the use of apps for language intervention. Reports indicate that SLPs are selecting apps by word-of-mouth and popularity. One of the difficulties in evaluating apps is related to the lack of consensus about which features are important in an app when providing speech-language therapy to children.

Aim: This study aimed to investigate the features of apps that SLPs regard as valuable for language intervention with children and how SLPs were using apps in their intervention.

Method: The study employed an explanatory, sequential mixed-method approach using SLPs in 6 predominantly English-speaking countries. A self-developed online survey (N = 338) identifying the features of apps was distributed to SLPs who use apps. This was followed by a semi-structured interview with some participants (n = 16) in order to obtain further insights from the survey. Descriptive statistics were used to examine the survey results. Interview data were explored using thematic analysis.

Findings: The findings show that SLPs view apps as an engaging and motivating tool for therapy to facilitate their intervention goals. The lack of guidelines to support SLPs in their selection of apps has contributed to the selection of apps based on popularity and word-of-mouth rather than feature matching. Findings showed that specific content and design features of apps may support effective intervention, however these features need to be carefully evaluated in terms of the underlying principles of language intervention,

multimedia learning and learning. Features that may impede effective intervention must also be considered. In addition, the social and pragmatic aspects of communication must be contemplated when using apps.

Conclusions: A feature-matching checklist was developed in order to assist SLPs select apps based on feature matching. The findings from the study highlight the need for SLPs to engage more deeply with the theory underlying multimedia learning so that this information can be used to contribute to evidence-based practice when using apps for intervention. This study, calls for SLPs to make a concerted effort to engage in research around apps and app use.

Keywords: apps, iPad, speech-language pathology, language intervention, app features

ACKNOWLEDGEMENTS

Dr Victor de Andrade: Thank you for taking me on. I suspect that you did not know what you were letting yourself in for in your undertaking but you rose to every challenge you were presented with. You provided me with strength, support, encouragement and understanding in my many times of insecurity. Thank you for spurring me on and making my brain churn. Obrigado!

Andrea Fourie: Thank you for picking up the pieces, holding them together and not letting them go. Your encouragement, practical advice and insight helped me see the light and make sense of a muddle.

Dr Petra Gaylard: Your efficiency, advice and words of encouragement were so important to me.

To my friend **Karen Levin**, your wisdom, practicality, insight and support were unwavering. Your clinical and academic expertise is a gift. Without people like you, the field of speech-language therapy would be poorer. Without you as a friend, I would be impoverished. Your love of knowledge and learning is inspiring. Thank you for sharing your love.

My mom, **Yvonne Heitner**, I cannot begin to put my gratitude into words. You are always there to step up to the plate at the drop of hat. You make things happen, and without you this study could not have happened. Thank you for every meal that you made. For pulling the family together when everything was so difficult. You are my rock and my inspiration.

My family: **Dean**, we didn't get to share student life as I envisaged, but your trips to the library for me were valued. **Kelly**, you took on your grade 11 and matric years with

aplomb and yet you still managed to always be there to help. I may not have always been there for you, but you were always with me.

My husband **Martin** - you sat alone over many weekends while I hijacked the dining room table as my work place. You never complained and supported me every step of the way. Without you by my side, I could not have done this. Thank you for listening to my ramblings and cheering me on when I needed it.

DEDICATION

This study is dedicated to my late father Dr René Heitner. His love of academia and clinical practice was something that he cherished. It is through this study that I have finally been able to marry the two. Dad, there is never a day that goes by that I don't think of you. I know that you would be proud of me.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AAC	Alternative Augmentative Communication
ASHA	American Speech Hearing Association
ASD	Autism Spectrum Disorder
Aus	Australia
CASLPA	Canadian Association of Speech Language Pathologists
EBP	Evidence Based Practice
EI	Early Intervention
NZSTA	New Zealand Speech language Therapists' Association
RCSLT	Royal College of Speech Language Therapists
RTT	Rehabilitation Treatment Taxonomy
SA	South Africa
SASLHA	South African Speech Language Hearing Association
SPA	Speech Pathology Australia
SLP	Speech-Language Pathologist
UK	United Kingdom
USA	United States of America

TERMINOLOGY

App:	Abbreviation of the word application. An app is a self-contained programme downloaded onto a mobile device such as a mobile phone or tablet.
Android:	Mobile operating system developed by Google.
FaceTime:	A video and audio telephone service that makes it possible to conduct one-on-one video calls between Apple iPhone, iPad, and Mac notebooks and desktops.
iOS:	Operating system developed by Apple Inc. exclusively for its hardware.
iTunes:	Apple iTunes is a software application for downloading, playing and managing audio and video files. The application also provides users with easy access to the iTunes Store.
iPad:	A touch screen tablet produced by Apple.
Lite app:	A lite app is an abbreviated version of a software application that is either free of charge or reduced in price.
Skype:	An Internet telephone service that allows users to communicate using voice and video.
Tablet:	A wireless, portable personal computer with a touchscreen interface.

Touch Screen:	A computer display screen that is sensitive to pressure. The user interacts with the computer by touching pictures or words on the screen.

Chapter 1: Introduction

This study investigated the use of apps by an international group of English-speaking Speech-Language Pathologists (SLPs) in their intervention with children [1] with language disorders. The study considered the beliefs, practices and use of apps by SLPs in order to identify the features of apps that are effective for intervention.

SLPs facilitate communication and language in children with communication impairments that include, but are not limited to conditions such as language delays, intellectual and physical disabilities, Autism Spectrum Disorder (ASD), and hearing impairments. Whilst language development has been studied extensively in the literature, there is still a lack of agreement among theorists about how language is acquired. The complexity of the language system and the relationship of language and communication to other domains of development pose a number of challenges for effective intervention (Kaiser & Roberts, 2011). There are a number of intervention approaches, strategies and prompts that are designed to facilitate language (Kaderavek, 2011). SLPs also employ a variety of materials and activities in order to maximize communication opportunities and learning (DeCurtis & Ferrer, 2011). The development of apps for intervention has resulted in the incorporation of technology by SLPs as part of their clinical intervention. Any intervention that is used by SLPs must be justifiable and aligned with principles of Evidence-Based Practice (EBP). This includes the use of apps. Therefore, this study is presented against a background of EBP.

[1] The United Nations Convention on the Rights of the Child defines *child* as "a human being below the age of 18 years unless under the law applicable to the child, majority is attained earlier".

1.1 Apps

Applications or apps are the end-user software designed for mobile technology that enables the user to perform a particular task (Purcell, Entner, & Henderson, 2010). Whilst apps have been developed for both Android and iOS platforms, Apple appears to be the predominant force in the educational app market.

1.2 Technology in Education

The utilization of computer technology for educational purposes is not a new phenomenon. However, historically, the field of education has been slow to adopt new technologies (Cumming & Rodríguez, 2013). The introduction of the Apple iPad in 2010 resulted in a dramatic increase in the use of technology for teaching and learning because of the abundance of education applications (apps) (Hamshire & Lachkovic, 2016; Shuler, 2009 as cited by Powell, 2014, p. 20). Many schools across the world purchased the iPad for students with and without disabilities for instructional purposes because of its appeal to students, educators, clinicians and parents in terms of affordability, accessibility, versatility, engagement and motivation (Bush & Hall, 2012; Douglas, Worjcik, & Thompson, 2012; Hynan, Murray, & Goldbart, 2014; Murdock, Ganz, & Crittendon, 2013; Newton & Dell, 2011.)

Technological advances have led to a shift from more traditional technological resources to mobile devices and tablet devices such as the iPad. Features such as portability, the light weight of the iPad, the absence of separate input devices (such as a mouse and keyboard), and the fact that they are specifically designed to accommodate a number of apps – many of which have a child-friendly intuitive design, have the potential to make a positive difference to early education (Clark, Austin, & Craike, 2015; Kucirkova, 2014). Karsenti and Fievez (2013), in their study on iPads in education, report that the Apple iPad has captured

over 75% of the education market worldwide. The number of educational apps is growing rapidly and in June 2016 over 130 billion apps had been downloaded from the App Store. At that time, a total of 2000,000 apps were available in the App Store. Education apps were the third-most popular category, with a share of 9.21% of all apps being education apps (www.statista.com). Educators and parents of children who have or work with children who are experiencing educational difficulties are attempting to find apps that facilitate academic improvement. However, they often express challenges in finding effective apps (Ok, Kim, Kang, & Bryant, 2016).

Despite the growing uptake of apps in the educational field, empirical findings regarding their efficacy are lacking (Clark & Luckin, 2013; Maddux & Johnson, 2012). Ayres (2015) highlights that most of the research that addresses multimedia learning is focused on Science, Technology, Engineering and Mathematics (STEM) topics and there is limited research in areas outside of this realm. Hirsh-Pasek et al. (2015) state that given the limited precedent of effective app use, there is a need to propose principles for the design of appropriate apps that will offer a greater likelihood of educational benefits.

1.3 Apps used by Speech-Language Pathologists

Many SLPs have adopted the use of mobile technology into their clinical practices. Whilst many general education apps can be incorporated for use in language therapy, there are apps that are specifically designed for use with children and adults who experience speech and language difficulties. These apps are designed to incorporate a wide variety of language goals. Some of these include apps specifically designed to facilitate the learning of targets such as following directions and sequencing, verbs, syntax, pronouns, vocabulary, narrative skills and social skills. However, there are no data available for these apps and

unless they are publicised to speech pathologists, it can be difficult to source them (Fernandes, 2011; Gosnell, Costello, & Shane, 2011).

1.4 Research on Apps in Speech Pathology

The potential of the apps to contribute to the field of speech-language pathology resulted in early uptake of their use by SLPs (Fernandes, 2011). There have been a number of research studies investigating the use of apps. The studies that were identified are presented in Table 1. The studies are presented chronologically and separated in terms of the type of disorder that the participants presented with.

Table 1.

Summary of Research using Tablets in Speech-Language Pathology

Authors	Title	Technology	Targets	Participants	Findings
Achmadi et al. (2012)	Teaching advanced operation of an iPod-based speech-generating device to two students with autism spectrum disorders	iPod	AAC	Two students with ASD	Learning advanced. Operation of the iPod promoted greater independence in using such devices for multi-step communication.
Cardon, (2012)	Teaching caregivers to implement video modelling imitation training via iPad for their children with autism	iPad	Language skills using video modelling	Four children with ASD	All children increased imitation skills. Increase in expressive language. 3 children demonstrated increases in receptive language.
Flores, Musgrove, Renner, Hinton, Strozier, Franklin, & Hill (2012)	A Comparison of Communication Using the Apple iPad and a Picture-based System	iPad	AAC	Five students with ASD	Students preferred the iPad. 3 out of 5 students showed more independent communication. Teachers preferred the iPad.

Table 1. Continued

Authors	Title	Technology	Targets	Participants	Findings
Kagohara et al., (2012)	Teaching picture naming to two adolescents with autism spectrum disorders using systematic instruction and speech-generating devices	iPod Touch Proloquo2Go	Picture naming	Two students with ASD	Acquisition of labels in response to open and closed-ended questions for both participants.
Neely, Rispoli, Camargo, Davis, & Boles (2012)	The effect of instructional use of an iPad1 on challenging behaviour and academic engagement for two students with autism	iPad Apps: Little Matchups WritePad	Reduce Challenging Behaviours during academic demands	Two students with ASD	Reduction in challenging behaviour. Increased academic engagement when the iPad was used to deliver instruction versus traditional materials.
Ganz, Hong & Goodwyn (2013)	Effectiveness of the PECS* Phase III app and choice between the app and traditional PECS among pre-schoolers with ASD	iPad PECS system Traditional PECS*	Requesting	Three students with ASD	All participants demonstrated mastery of the app. Two participants preferred the app, 1 preferred traditional PECS.
Hourcade, Williams, Miller, Huebner, & Liang (2013)	Evaluation of Tablet Apps to Encourage Social Interaction in Children with Autism Spectrum Disorders	Dell XT2 Tablet running Windows	Social Interaction-Drawing, Music, Puzzle, Social Modelling	Eight students with ASD	App use resulted in increased verbal communication, physical interaction, and supportive comments. Improved engagement noted.

*PECS – Picture Exchange Communication System

Table 1. Continued

Authors	Title	Technology	Targets	Participants	Findings
Lee, Lang, Davenport, Moore, Rispoli, van der Meer, …& Chung (2013)	Comparison of therapist implemented and iPad-assisted interventions for children with autism	iPad Photos See Touch Learn App	On-task behaviour Correct responses Session duration Challenging behaviour	Two children with ASD	One participant improved in all areas when using the iPad. The other participant showed no difference.
Lorah, Tincani, Dodge, Gilroy, Hickey, & Hantula, (2013)	Evaluating picture exchange and the iPad as a speech generating device to teach communication to young children with autism	iPad	Requesting (mands) Preference of participants	Five participants with ASD	Independent requesting and maintenance was higher for 4 participants using iPad.
Sigafoos, Lancioni, O'Reilly, Achmadi, Stevens, Roche, et al. (2013)	Teaching two boys with autism spectrum disorders to request the continuation of toy play using an iPad®-based speech-generating device	iPad Proloquo2Go	Requesting continuation of play	Two participants with ASD	Acquisition of request for each participant. Maintenance and generalization of skills was seen.
Couper et al. (2014)	Comparing acquisition of and preference for manual signs, picture exchange, and speech-generating devices in nine children with autism spectrum disorder	iPod Touch, iPad	Requesting	Nine children with ASD	8 participants preferred using iPod/iPad, one didn't demonstrate preference.
King, Takeguchi, Barry, Rehfeldt, Boyer, & Mathews (2014)	Evaluation of the iPad in the acquisition of requesting skills for children with autism spectrum disorder.	iPad Proloquo2Go	Requesting	Three participants with ASD	Requesting improved in all participants. All participants showed increased vocal requests.

Table 1. Continued

Authors	Title	Technology	Targets	Participants	Findings
King, Thomeczek, Voreies, & Scott, (2014)	iPad use in children and young adults with Autism Spectrum Disorder: An observational study.	iPad 63 apps	Game Apps Academic Apps AAC	Six children & young adults with ASD	The presence of an education professional increased appropriate app use. AAC use was limited even though all participants were non-verbal
Agius & Vance (2015)	A Comparison of PECS and iPad to Teach Requesting to Pre-schoolers with Autistic Spectrum Disorders	iPad	Requesting AAC	Three preschool children with ASD	All participants learnt 3-step requesting. More prompted trials were required on the iPad. Participant preference probes were inconclusive.
Therrien & Light (2016)	Using the iPad to facilitate interaction between preschool children who use AAC and their peers	iPad	Turn-taking	Two participants with ASD Six peers	1 participant demonstrated improved turn taking. Second participant showed initial gains, but this was not maintained.

Table 1. Continued

Authors	Title	Technology	Targets	Participants	Findings
Des Roches, Balachandran, Ascenso, Tripodis, & Kiran (2014)	Effectiveness of an impairment-based individualized rehabilitation program using an iPad-based software platform	iPad	Language and Cognitive Skills	Fifty one participants with Aphasia - stroke and TBI*	Experimental participants used the app more. Greater improvements in accuracy and latency on tasks. Greater improvements were noted on standardized tests.
Kurland, Wilson, & Stokes (2014)	iPractice: Piloting the effectiveness of a tablet-based home practice program in aphasia treatment	iPad – iBooks with individualised programmes	Expressive naming	Six participants with Aphasia	Home practice on the iPad. Maintenance & improvement over a 6-month period. Satisfaction using the iPad.
Choi, Park, & Paik (2016)	A Tele-rehabilitation Approach for Chronic Aphasia Following Stroke	iPad Telepractice	Auditory comprehension, reading comprehension, repetition, naming, writing, verbal fluency	Eight participants with chronic Aphasia	Improved overall language function in all participants. Degree of improvement was strongly associated with usage time. Satisfaction with iPad use was rated high.
Stark & Warburton (2016)	Improved language in chronic aphasia after self- delivered iPad speech therapy	iPad – App Language Therapy Control – non language mind game on iPad	Reading, Writing, Naming, Comprehension	Ten participants with Aphasia	Self-delivered training. Improvements in expressive chronic aphasia noted.

*TBI – Traumatic Brain Injury

A number of themes can be extracted from this summary of available studies. Firstly, there is a strong bias in the literature on research that is focussed predominantly on intervention using the iPad for Alternative and Augmentative Communication (AAC) (Achmadi et al., 2012; Flores et al., 2012; Kagohara, et al., 2013), autism (Cafiero, 2012; Flores et al., 2012; Therrien & Light, 2016; Virnes, Kärnä, & Vellonen, 2015; Sennott & Mason, 2016) and aphasia (Choi, Park, & Paik, 2016; Des Roches, Balachandran, Ascenso, Tripodis, & Kiran, 2015; Kurland, Wilkins, & Stokes, 2014; Stark & Warburton, 2016). Thus, information yielded from these studies relates specifically to the difficulties experienced by these populations.

Secondly, the propensity towards using the iPad as opposed to Android Tablets is also reflected in the research, and only one study used a Windows-based tablet.

The results of these studies reflect positive outcomes in the main, although there have been reports of less positive outcomes. The targets included a range of behaviours such as increased independence and expressive language, comprehension, spelling, requesting, and reduction of challenging behaviours. Many of the researchers also recommended that the use of technology should be based on individual choice. Results also indicated that the majority of participants in the research exhibited a preference for using the iPad as a speech-generating device.

Lastly, none of the research cited identified which factors facilitated learning with iPad technology (although some authors hypothesised about contributing factors and factors that impeded effective use). Additionally, it is apparent that the use of iPad technology is

motivating and appears to be more socially acceptable contributing to increasing uptake of this device in special needs populations[2].

1.5 Research on Apps for Language Intervention

Despite the impetus towards using iPads for education, there is a paucity of research in terms of using this technology for language learning. Hirsh-Pasek et al. (2015) state that the lack of empirical studies on the educational nature of apps has been impeded by a lack of agreement on how to conduct such a content study. The researcher conducted a hand search of journal articles published since 2010 after the iPad was released, to identify research on apps in speech-language pathology that specifically include language intervention using apps.

This extensive review of the paediatric language literature identified only one published study (Rodríguez & Cumming, 2016) that specifically related to language intervention using apps. The authors reiterate the dearth of research on the use of mobile devices and applications, particularly in the area of language development of elementary school children with language-based disabilities.

1.6 Selection of Apps by SLPs

The literature on how SLPs are selecting apps in the field of speech–language therapy, particularly related to use with children with specific language impairment or populations who are not defined as having complex communication needs[3], is also

---

[2] The individual requirements (as for education) of a person with a disadvantaged background or a mental, emotional, or physical disability or a high risk of developing one (Merriam Webster, dictionary)

[3] Complex communication needs is a term used in the literature to describe people who have little or no speech, where there are many possible causes. Within the context of the International Classification of Functioning and Disability — ICF (World Health Organization 2001), "complex communication needs" ……..(continued)

lacking. Falloon (2013) states that there is a need for researchers obtain the perspectives of teachers using the technology in order to support better alignment of educational theories to research. However, selecting an appropriate app to use with students can be overwhelming, expensive, time consuming and may not produce an outcome of acquiring skills aligned with what is being taught (Powell, 2014). Professionals including, SLPs are making decisions about purchasing apps based on word-of-mouth, descriptions from the developers and popularity rather than clinical feature matching (Gosnell, Costello, & Shane, 2011). Currently, the resources available to support educators in selecting apps are limited in that they do not make clear distinctions about apps based on their purposes or align to a theoretical framework for using technology. Cherner, Dix, and Lee (2014) note that in order to make an appropriate selection of an app, the user needs to consider the intended purpose of the app.

Similarly, research on the efficacy of using specific apps in speech-language therapy is also lacking. In order to evaluate the suitability of an app, educators need to decide on what makes an app worthwhile and which features are important (Walker, 2011). The features of an app for language therapy are not necessarily the same as the features needed for a general educational app. A number of researchers have put forward criteria for evaluating educational apps using rubrics (Buckler & Peterson, 2012; Hennig, 2014; Jonas-Dwyer, Clark, Celenza, & Siddiqui, 2012; Gonzalez, 2014; Lee & Cherner, 2015; Ok, Kim, Kang & Bryant, 2016; Powell, 2014; Sweeney, 2010; Wakefield & Schaber, 2012; Walker, 2011). However, there is no uniformity or consistency in the criteria. Lee and Cherner (2015), emphasise that because

---

relates to people who have a severe limitation in communication functioning, related to their health condition, body structures and functions, activities and participation, environmental factors and personal factors.

a variety of apps exist for specific purposes, creating a single rubric to evaluate all varieties of educational apps is not possible.

Software Advice (http://www.softwareadvice.com/medical/industryview/home-speech-therapy-report-2014/) did a review of adult-patient usage of speech therapy software. They found that 74% of the patients surveyed were using, or have used speech therapy software to practice at home and the majority of patients (89%) noticed improvements. The top criterion for choosing particular software was because of therapist recommendations. Sutton (2014) reports that technology has advantages such as providing auditory or visual feedback cues, and stimuli that you can hear and interact with, rather than just static, printed materials.

1.7 Reviewing apps

A number of websites and blogs are dedicated to reviewing mobile apps. Many of these sites are written by SLPs. However, although many practitioners review apps, a uniform evaluation system has not been established to review apps (Walker, 2011). Hennig (2014) notes that there are no established guidelines for writing an app review and anyone who has purchased an app can contribute reviews on the iTunes store. Hennig (2014) recommends using blogs or app review sites as a source of app reviews. Whilst the credentials of blog reviewers may be sound in some cases, there are a number of potential pitfalls to blog reviews or app review sites. Firstly, although review sites are purportedly based on expert opinion, the biases and experience of the professional reviewing the app need to be taken into consideration. Unlike traditional software developers, app-developers come from diverse backgrounds (Weng & Taber-Doughty, 2015). Therefore, it is important for clinicians to be able to select appropriate apps. Walker (2011) highlights that the reviewer's perspective, targeted audience, cost and preferred learning style may influence the review of

the app.

Secondly, app developers provide apps to app review sites free of charge and consequently reviews are often favourable. These inconsistencies are noted by Green, Hechter, Tysinger, and Chassereau (2014 p. 66) who state, "the same mobile app might be highly rated by one educator, and completely derided by another." The app store for iOS mobile apps allows users to express their level of satisfaction regarding apps they have purchased; however these reviews may not be helpful because it is not known who is writing the review.

1.8 Evaluation of apps

Reiser and Keglemann (1994) reviewed a number of different methods of evaluating software. They found that almost all of the evaluation procedures involved having evaluators use a rating form to evaluate a variety of features of the software. Since apps are a type of instructional software programme, the general principles for evaluating multimedia software are adopted in this study. Walker (2011) notes that the evaluation rubric has been widely embraced by educators as a useful evaluation tool. Therefore, a rubric would allow clinicians to rate features of an app using consistent terminology.

Airasian and Russell (2008) define rubrics as "a set of clear expectations or criteria used to help teachers and students focus on what is valued in a subject, topic, or activity" (p. 223). The expectations are usually descriptive and "…help develop a common understanding of what is valued in a performance" (p. 223). A rubric "includes both the aspects or characteristics of a performance that will be assessed and a description of the criteria used to assess each aspect" (p. 224). Most rubrics have two features: 1) a list of criteria or

standards of assessment, and 2) gradations of quality with descriptions of what the criteria look like at different levels.

Boone and Higgins (2007) emphasise that user design and instructional focus of educational software is much more complex when it comes to students with disabilities. The authors state that the content should facilitate teacher-led instruction and users should make informed decisions about whether the software can facilitate learning objectives. In addition they suggest that the following variables should be included when evaluating educational software: (a) feedback and error correction opportunities, (b) multiple practice/examples and opportunities to review errors, (c) empirically validated instructional strategies or principles (e.g., direct instruction), (d) systematic curriculum organized with logically sequenced skills, (e) adjustable individual preferences (e.g., pace, level, time, goal), (f) student data recording for progress monitoring, (g) motivation enhancements, and (h) content provision in multiple formats (e.g., text, graphics, spoken words).

Walker (2011) states that in order for educators to evaluate apps effectively, there is a need for common language and structure. Although Walker has empirically validated his rubric (2013), Lee and Cherner (2015) have criticised its validity based on a number of factors. They state that Walker's rubric is not directly linked to research grounded in theory and best practices. The rubric is not sufficiently detailed and the specific terms used are too limited. Additionally, they felt that the 4-point system to evaluate the quality of apps does not allow for a more nuanced distinctions to be made. Weng and Taber Doughty (2015) emphasise that when evaluating apps, factors that facilitate learning must also be taken into account. These factors include increasing attention, decreasing cognitive load and providing feedback.

In discussing the use of the iPad and mobile technology for AAC, McNaughton and Light (2013) emphasise that "perhaps the greatest danger in the iPad /mobile technology revolution is that the excitement over these new technologies will result in an isolated focus on the technology alone, to the neglect of the true end goal – communication" (p. 6). This concern resonates not only within the realm of AAC, but also with respect to the use of technology for all learning. The focus should be on the effect of the technology on learner activities, intentions and goals as they engage in learning, rather than on what the technology can do (Beckman, 2010; Taylor, Sharples, Malley, Vavoula, & Waycott, 2006). Ultimately, although knowledge of prevailing theories is important, the focus of intervention must be therapeutic.

1.9 Rationale for this Study

The development of technology for learning continues to increase, and as a result the anecdotal evidence is that more and more therapists are incorporating the use of technology and in particular, the iPad, into their practice in order to meet the needs of the clinical population that they serve. The limited research on the use of apps in clinical practice means that currently there is no framework to consider when evaluating apps. Consequently, there is a pressing need for research that looks at how SLPs can incorporate apps into therapy that resonate with the principles of best practice. Research that examines the factors that are used in the selection of apps will also guide further research on the efficacy of using apps for clinical practice and allow SLPs to match the unique needs of the individual with the features of the app. In their meta-analysis on the efficacy of treatment for children with speech and language delay, Law, Garrett, and Nye (2004) highlight that many of the studies provide too little information about the interventions in order to replicate them. In their study on treatment procedures in specific language impairment, Smith-Lock, Leitão, Prior, and

Nickels (2015), highlight the need to identify the "active ingredients" (p. 4) during intervention. It is therefore important to research this area by identifying the specific features used in language applications. In addition, communication with app developers with regard to these factors could potentially result in a higher standard of apps for intervention.

1.10 Organisation of this Study

This thesis attempts to address the paucity of research on the use of apps for language by SLPs with children with language impairments. In chapter one, I have provided a background on the use of apps in the field of education, as well as a summary of research conducted in the field of speech-language pathology. Factors that have impeded research are discussed. The current practices of SLPs when selecting apps for language intervention are highlighted but the efficaciousness of intervention in which apps are used is unknown. The chapter concludes by providing a rationale for this study.

Chapter 2 presents a detailed literature review, which relates to the theoretical underpinnings that underlie the use of apps for language intervention. This chapter provides the reader with important background information, which is of relevance to the research findings and discussion presented later on.

The methodology that was used to determine the aims of the research is presented in chapter 3. The aims of the study are presented and the design of the study that was selected is discussed and motivated. Participant selection criteria and the sampling methods are described. This chapter also details how the obtained data was analysed and the validity and trustworthiness of the results is described.

Chapter 4 presents the results of the study. The results are presented in two parts in line with the methodology used in the study. The first section describes the quantitative findings from the survey. The second section describes the findings from qualitative

component of the study.

In chapter 5, the reader is presented with a discussion of the results in relation to what is known in the literature about language intervention, mobile learning and evidence-based practice.

Chapter 6 draws conclusions from the study. The implications of the findings are addressed in relation to clinical applications and future research.

Chapter 2: Literature Review

This chapter provides an overview of the components that were considered when examining the use of iPad apps for language intervention. The notion of Evidence-Based Practice (EBP) forms the foundation of any intervention. Thus this study is presented against a background of EBP as the basis for selecting and using apps for intervention. Underlying the use of apps, theories of multimedia learning are considered together with frameworks for mobile learning and their application to touch screen technology. Lastly, the use of language intervention strategies and learning principles are addressed. These constructs are important in order to provide a background to the assumptions that guide the evaluation of apps.

2.1 Evidence-Based Practice

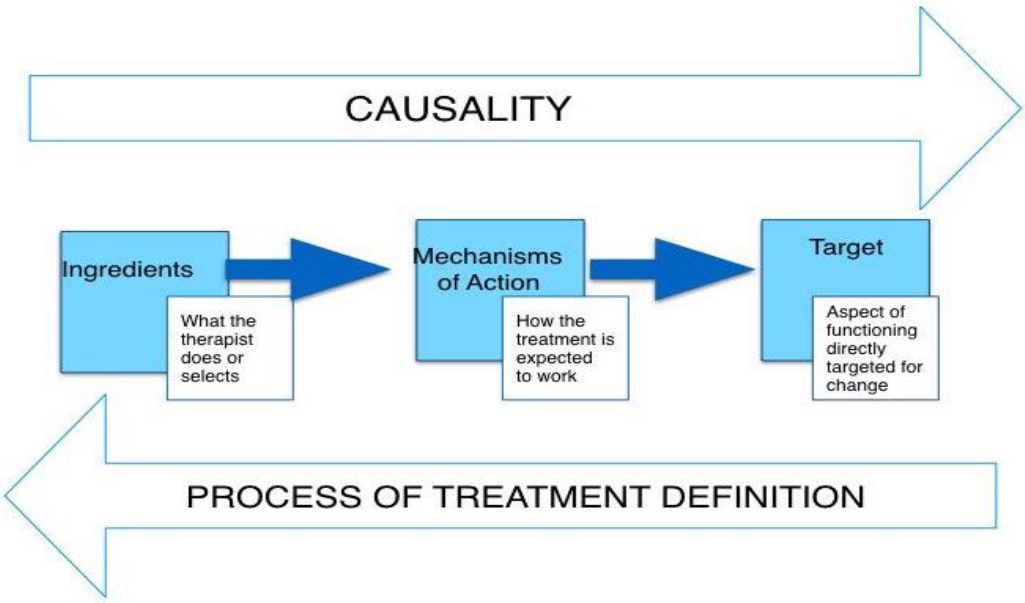
Evidence-based practice (EBP) is a well-established concept in the field of speech-language pathology (Lof, 2011). The American Speech and Hearing Association (ASHA) emphasises that the goal of EBP is the integration of: (a) clinical expertise/expert opinion, (b) external scientific evidence, and (c) client/patient/caregiver values to provide high-quality services reflecting the interests, values, needs, and choices of the individuals that are served by SLPs (ASHA, 2005).

Durkin and Conti-Ramsden (2014) are of the opinion that one of the challenges facing clinicians is that technology is changing faster than it can be evaluated it in terms of the

effects and uses. They note that while "systematic evaluations using conventional techniques must remain pivotal to high quality research" (p. 50) clinicians can provide a grounded basis for guiding and enabling good professional practice. Squires and Preece (1999, p. 467) note, "informal predictive evaluations rely on past personal experience to make value judgements about the quality and potential use of an educational software application." It is therefore important to consider the perspectives of the SLPs using these apps in order to adopt a situated perspective on the clinical use of apps by SLPs. To this end, the concept of 'practice based evidence' (Barkham & Mellor-Clark, 2003) is central to identifying the features of an app that SLPs deem as important. This ensures that research is relevant to clinicians in clinical settings and facilitates treatment quality.

However, in order to integrate practice-based evidence with evidence-based practice, there is a need to specify the details of treatment so that the key components of treatment can be identified and replicated. Hart, Ferraro, Myers, and Ellis (2014a) point out that reliance on practice-based evidence alone is problematic because many treatments that clinicians conceptualise as specific are in fact combinations of treatments. Practice-based evidence does not consider the mechanisms that affect change on the target and relies on therapist self-report of therapy contents. This is subject to memory distortion and other biases. Additionally, Hart et al. (2014b) note that this approach risks separating treatments that are similar because descriptions are aligned to a specific discipline. For example, treatments aimed at getting dressed described by an occupational therapist may share attributes in common to training in sequential activities in a narrative task. Conversely, there is a risk of combining dissimilar activities under the same name. For example, memory training can refer to training someone to use a diary to retrieve information, or to recall a sequence of events. However, the mechanisms and treatment ingredients in these tasks are diverse and must be specified in order to identify the active ingredients of therapy.

Turkstra, Norman, Whyte, Dijkers, and Hart (2016) propose a Rehabilitation Treatment Taxonomy (RTT) in order to specify the details of treatment based on the underlying theory rather than surface characteristics. Treatment theory refers to a conceptual model that identifies the specific theories that explain why and how a particular treatment will work (Whyte, 2014). The RTT is specified using three elements of treatment theory: (a) the 'targets' which are the aspects of functioning that will change as a result of the treatment; (b) the 'ingredients', which are the specific actions taken by the clinician to effect changes in the target and (c) 'mechanisms of action', which are the known or hypothesized means by which ingredients exert their effects. Specifically, this is the underlying process that



transforms the therapy into effective change in the client's target behaviour (Hart et al., 2014a). These aspects interact with one another. Figure 1 depicts the three-way causal interaction.

Figure 1. Casual and temporal aspects of the tripartite structure of treatment theory reproduced from Toward a Theory-Driven Classification of Rehabilitation Treatments (Hart et al., 2014)

Unlike linear schemes, which are dependent on the attainment of a lower level in order to progress to a higher level, rehabilitation treatment cannot be explained in a linear progression. The causal direction effects change on the recipient of treatment (patient or caregiver). The process of planning the treatment flows in the reverse temporal order. That is the therapist considers the target that he or she is attempting to change, then the mechanism, and lastly implements the process in order to put the mechanism of action in motion. In this framework, both the target and the ingredients are measurable, but the mechanism of action is generally unobservable and must be inferred. The mechanisms usually involve some form of learning. Identification of the kind of learning that is taking place will allow the clinician to modify the ingredients if necessary. It is also important to consider the characteristics of the

patient when selecting the ingredients (Hart et al., 2014).

Turkstra and her colleagues (2016) have identified four broad groups of treatment components. Each of the components is mutually exclusive with respect to the types of targets addressed and ingredients that are necessary to change them. The following treatment components have been identified; (a) changing the size and shape of tissues (e.g., removing teeth to reduce over-crowding in the mouth to allow for good oral closure); (b) changing the output of organ systems (e.g., increase jaw strength to facilitate oral closure); (c) improving the quality, speed, efficiency, or automaticity of skilled performances at either a function or activity level (e.g., vocabulary retrieval by addressing vocabulary in specific categories); and (d) changing cognitive or affective representations, that is, increasing the amount and accuracy of knowledge or changing attitudes and beliefs (e.g., by counselling and education) (p.4). Whilst the authors acknowledge that it may be difficult to separate these groups, it is important to divide big targets into smaller sub-skills in order to identify the treatment components and the active ingredients. Identification of the active ingredients that effect change on the target may enable clinicians to think more critically about the effect of the treatment. This may result in improved treatment efficiency. The use of multimedia learning may improve the quality, speed and efficiency of the target and/or contribute to changing the cognitive or affective representations of the target.

2.2 Theories of Multimedia Learning

The underlying rationale for multimedia learning is the belief that people learn more deeply from words and pictures than from words alone (Mayer, 2002). Multimedia is increasingly providing richer environments for learning by presenting information in a wide variety of different formats. However, extraneous information has also been shown to distract

children's attention and interfere with comprehension (Kirkorian, Pempek, Murphy, Schmidt, & Anderson, 2009). This presents a challenge for both learners and instructional designers to effectively combine this information to facilitate learning (Reed, 2006).

There are a number of theories that have been put forward in an attempt to obtain more insight about how learning occurs within a multimedia context. An understanding of the cognitive basis of learning with multimedia is important (Mayer & Moreno, 2003), as this will suggest criteria that may be relevant when selecting apps for language intervention and learning.

Multimedia learning models suggest that in order for learning to take place, information has to be processed in working memory before being stored permanently in long-term memory (Baddely, 2003; Kirschner, 2002). Working memory refers to the ability to actively hold information in mind and manipulate it to achieve complex tasks such as reasoning, comprehension and learning. These include executive attention, information integration, processing and retrieval (Baddeley, 1997).

Paivio initially put forward his Dual Coding Theory (DCT) in 1971 (Paivio, 1991). However, he emphasizes that the theory is in fact a multiple coding theory. Accordingly, verbal and nonverbal information are processed in two separate but interconnected channels. The theory distinguishes three kinds of processing. Representational processing refers to the direct activation of the verbal representations by linguistic stimuli and images by non-verbal stimuli. Referential processing refers to the cross system activation required in imaging to words and naming objects. Associative processing entails activation of representation within either system accounting for the spread of association among words or among images. All cognitive tasks require representational processing and some may involve all three. Thus,

processing the two kinds of stimuli simultaneously does not result in cognitive overload but, on the contrary, facilitates learning (Paivio, 1991).

The revised working memory model proposed by Baddely (2003) consists of four components: (a) a phonological loop which is responsible for maintaining and manipulating speech based information, (b) a visuo-spatial sketch pad for maintaining and manipulating visuo-spatial information, (c) a central executive which is responsible for selecting strategies and integrating information, and (d) an episodic buffer which is a storage system that can integrate memory codes from different modalities (Reed, 2006). Baddely makes the assumption that working memory has a limited capacity. In order to compensate for this 'deficit', storing some information as a verbal code and some information as a visual code will facilitate learning. Reed (2006) highlights that a limitation of Baddely's model is that he does not account for semantic information that is important for storing new information in long-term memory.

There has been a great deal of attention in the literature related to addressing working memory deficits in order to facilitate improvement in related cognitive and language deficits. Some of the research (Klingberg, 2010; Morrison & Chein, 2011) reports an improvement in overall cognitive functioning when children are given working memory training. However, Shipstead, Redick, and Engle (2012) caution that much of the research has not placed sufficient emphasis on training effects, and the development of an empirically based account of working memory. Therefore it is important to take this into account when evaluating the processing and, or the working memory demands of an app.

Sweller's (1994) cognitive load theory accounts for limitations in working memory by differentiating between the cognitive effort required for new learning versus the automaticity that occurs once transfer of learning has occurred. Extraneous cognitive load is important for

multimedia design because the cognitive effort required to mentally integrate distinct sources of information may be reduced by physically integrating the information within the multimedia application (Reed, 2006). Instructional designs that do not take this limited capacity into consideration can result in a large cognitive load and disrupt learning.

In order to account for the cognitive load that impacts on multimedia learning, Mayer and Moreno (2003) have proposed a cognitive theory of multimedia learning. This theory is based on three underlying assumptions: (a) verbal and visual information are processed separately; (b) there is a limited amount of processing capacity available in the verbal and visual channels; and (c) learning requires active cognitive processing in the verbal and visual channels. Accordingly active processing of multimedia information requires five cognitive processes: selecting words, selecting images, organizing words, organizing images and integrating. These processes place demands on the cognitive capacity of the information processing system. Figure 2 depicts the different modes of knowledge representation.

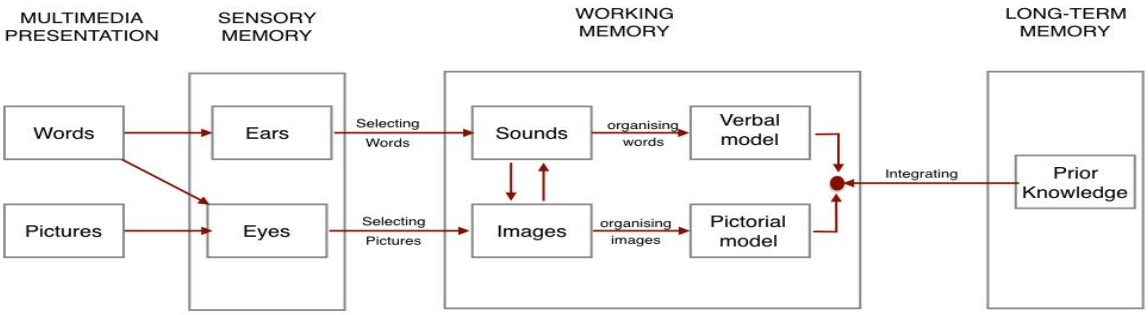


Figure 2. Theory of Multimedia Learning reproduced from Nine Ways to Reduce Load in Multimedia Learning Mayer, R and Moreno, R (2003) Educational Psychologist 38(1), p. 44 Reproduced with permission.

In order to reduce the extraneous cognitive load, and the demands on working memory, Mayer (2003) and Mayer and Moreno (2003) have identified a number of principles for multimedia learning.

- Multimedia principle: Students learn better from words and pictures than from words alone.
- Spatial contiguity principle: Students learn better when corresponding words and pictures are presented near, rather than far from each other on the page or screen.
- Temporal contiguity principle: Students learn better when corresponding words and pictures are presented simultaneously rather than successively.
- Coherence principle: Students learn better when extraneous words, pictures and sounds are excluded.
- Modality principle: Students learn better from animation and narration than from animation and on-screen text.
- Redundancy principle: Students learn better from an animation and narration than from animation, narration and on-screen text.
- Signalling Principle**:** Better transfer of knowledge occurs when narrations are signalled. Signalling reduces cognitive load in auditory working memory by providing cues to the learner about how to organize the material.

- Pre-training Principle: The pre-training principle states that better transfer occurs when training on components precedes a narrated animation. This connects to the concept of chunking and building schemas. Learners have to create low-level schemas about a concept, before they can combine them into larger, more complicated schemas.
- Pacing Principle**:** Better transfer occurs when the pace of presentation is controlled by the learner, rather than by the programme.
- Individual differences principle: Design effects are stronger for low-knowledge learners than for high-knowledge learners. (Mayer 2001, cited by Reed, 2006).

Multiple codes only have the potential to increase student's understanding. Their successful use and integration rely on instructional principles (Mayer & Moreno, 2003).

Moreno and Mayer (2004) have also demonstrated that personalisation of information facilitates engagement and active cognitive processing which in turn leads to meaningful learning outcomes. Personalisation of information is strongly related to prior knowledge so that new information can be accommodated into existing knowledge or schema (Vygotsky, 1978).

In his commentary on Mayer's principals of multimedia learning, Ayres (2015) cautions that there is a lack of research investigating which multimedia designs best complement specific learning strategies. Furthermore, he states that when there are additional factors impacting on the interaction with multimedia learning, if not carefully considered, these will impede learning. As SLPs using multimedia learning with language-impaired children, it is therefore important to take cognisance of factors that may impact on learning.

2.3 Memory Transfer

In order to transfer memories beyond the specific details of the event, maturation needs to occur (Richmond & Nelson, 2007). For example, a child may initially refer to all people as ‘baba’, which reflects over-generalization of the memory, but as they mature, they learn to differentiate perceptually similar objects and they are able to encode and retrieve novel cues to retrieve a memory more discriminately. This developmental process is referred to as memory flexibility and is crucial to the adaptability of learning and memory because it allows past experience to be applied to a range of situations that are unlikely to be perceptually equivalent to the initial learning episode (Barr, 2013).

In multimedia learning, two-dimensional images can potentially result in difficulty transferring information to three-dimensional images. This can be due to perceptual difficulties or lack of symbolic understanding (Barr, 2013). Whilst it is posited that increasing the number of contextual cues, such as repetition, visual information and auditory information, minimizes the transfer deficit, memory constraints may play a role when using multimedia for language intervention (Barr, 2013). It is therefore important to consider the developmental and cognitive ability of the child when using multimedia learning.

2.4 Mobile Technology and Touch Screen Technology

2.4.1 Mobile learning. There are a number of descriptions of mobile learning (m-learning) which all highlight the connection between working with mobile devices and the process of learning that is mediated and facilitated by a mobile device (Danaher, Gururajan & Hafeez-Baig, 2009; Koole 2009; Pachler, Cook, and Bachmair, 2010; Traxler, 2009). Kearney, Schuck, Burden, and Aubusson (2012) define the central features of mobile learning as authenticity, collaboration and personalisation. The definition of mobile

technologies adopted in the context of this study is aligned with Godwin-Jones's (2011) description of emergent and mobile technological devices — such as iPod, new smartphones, and tablets. These mobile devices offer advanced built-in functionalities such as video cameras and voice recognition, text entry through either a virtual or mini-keyboard, as well as access to online software programs known as apps.

Crompton (2015) believes that m-learning cannot be directly compared to conventional electronic learning (e-learning) where devices are tethered in one location. Therefore m-learning requires a new theory. Crompton's theory of mobile learning highlights that the context of learning can take place anywhere that you carry and use a mobile device. Learning can take place in numerous environmental and social settings and can be formal, self-directed and spontaneous. Sharples, Taylor, and Vavoula (2005) describe the context as being constructed by the learner through interaction with the environment.

Connectivity describes two types of interactions (Crompton, 2015). These can be social connections (face-to-face or virtual) or connections made with the content provided by information available on the World Wide Web or a learning partner. Although Crompton (2015) acknowledges the role of conversation in her model, she includes conversation within connectivity. Sharples (as cited in Crompton, 2015, p. 313), and Taylor, Sharples, Malley, Vavoula, and Waycott (2006) propose that conversational theory is an important factor in m-learning. Conversation Theory is based on the work of Pask (1976) which states that learning occurs when two people are able to become informed about each other by formulating conversations about what one knows. Regarding learning with mobile technology, Sharples (2015) proposes that learning occurs using conversation and exploration as mobile devices act as a system in which knowledge can be created and shared. Therefore, whilst it is important to acknowledge the different features of m-learning that have been proposed, one

cannot ignore the importance of conversation and context, particularly when using m-learning for language intervention in the field of speech-language pathology.

M-learning differs from e-learning because the student is not restricted to times of day when they can sit in front of a computer. Thus learning can occur whenever the student wishes to learn. Time is therefore an important component of m-learning (Crompton, 2015).

Crompton (2015) states that personalisation encompasses context, connectivity and time because it affords the learner the choice of what, where, when and how they learn. Learning is personalized through applications, concepts and ownership of devices for the user. Park (2011) states that even though ownership of the mobile device may be temporary, research supports that even temporary ownership results in improved involvement in the learning process. Crompton (2013) notes, "the essence of m-learning is not in the learning or in the technology, but in the marriage between the two entities" (pg. 96).

Crompton's (2015) model of m-learning shown in Figure 3, reflects that there are a number of inter-connected attributes.

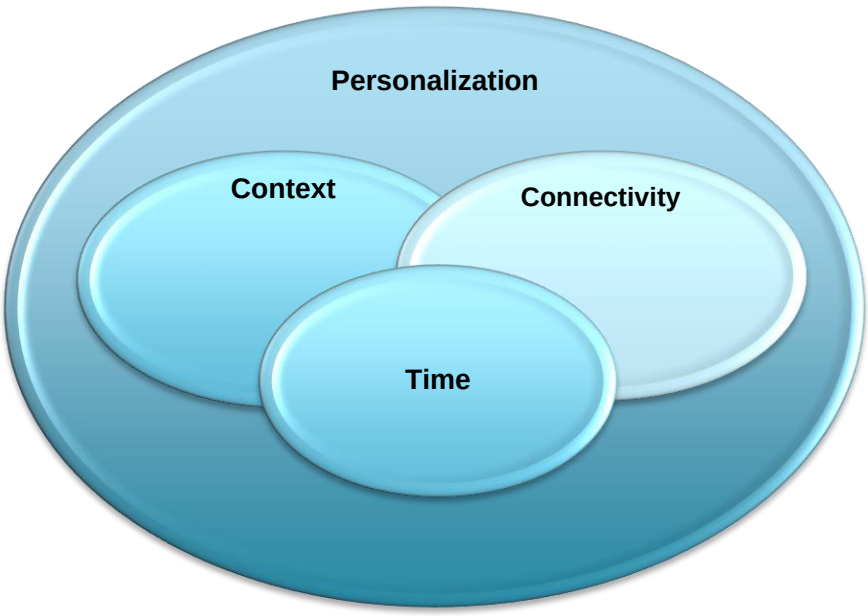


Figure 3. Crompton's Theory of m-learning from Crompton, H (2015) International Handbook of E-Learning Volume 1: Theoretical Perspectives and Research. (p. 311) Reproduced with permission.

The theories of mobile learning imply that the learner interacts with the mobile device and the app independently. However, with regard to speech-language intervention, the environment comprises mediation and interaction between the SLP and the child within the context of therapy.

2.4.2 Touch screen technology. The term touch technology refers to the development of digitalized interfaces that are able to detect the presence and location of a touch within a display area. Examples of such interfaces are touchpads, touchscreens, and interactive white-boards (Hwang, Wu, & Kuo, 2013).

The literature shows that students and teachers perceive touch screen mobile devices as intrinsically engaging (Crichton, Peglar, & White, 2012; Diemer, Fernandez & Streepey, 2013; Hutchison, Beschorner, & Schmidt-Crawford, 2012; Muis, Ranellucci, Trevors, & Duffy, 2015; Pachler, Bachmair, & Cook, 2010) and therefore more likely to facilitate learning outcomes. The inception of mobile touch screen technologies, most notably the iPad has rendered educational computing more portable and accessible (Cumming & Rodríguez, 2013; Flores et al., 2012; Gosnell et al., 2011).

The literature does not support a direct comparison of computer-based learning versus traditional learning and there is a lack of empirical evidence that demonstrates that children learn more or faster when using iPad technology (Clark & Luckin, 2013; Murray & Olcese,

2011; Park, Parson, & Ryu, 2010). Clark (1994) notes that the media per se do not impact on learning, but the instructional methods that can be embedded in the media affect learning. Joy and Garcia (2000) suggest that researchers and instructional designers must be cautious when interpreting results of media comparison studies. Although the literature purports to have found no significant difference in learning effectiveness between technology-based and conventional delivery teaching, many of the studies compared traditional (teacher-mediated) learning with technology-based devices as either a substitute for or supplement to the teacher. Therefore, a direct comparison cannot be made. Conversely, there is literature that supports the use of technology for learning because students find learning with technology meaningful and therefore they learn more effectively (Prensky, 2010; Sánchez, Salinas, Contreras, & Meyer, 2011). Haßler, Major, and Hennessy, (2016) conducted a review of tablet use on learning outcomes in schools. Studies that focused solely on the motivational aspect of tablet technology were excluded, since most studies have concluded that using tablet technology is inherently motivating. Their findings revealed that the majority of studies in their review (n=33) showed positive learning outcomes. However no conclusions as to how, or why, using tablets within certain activities resulted in positive learning outcomes.

Shively (2014) conducted an exploratory study to examine how children engage with digital media using interest driven projects. Her work found children independently chose the level of involvement with the project by playing, working and learning simultaneously. This suggests students who are engaged at their own independent level are most successful with the technology that is available. This also implies that the technology, or in this case apps, require different levels of differentiation in order to meet the needs of students.

With regard to the factors that should be considered in touch screen technology, the literature suggests that the interface design of the screen can impact on learning. This is because the design of the screen will draw the learner's attention to the information being displayed (Paas, Tuovinen, & Tabbers, 2003). In addition, the design interface can impact on learning, motivation, learning efficiency and quality of the interaction (Parlangeli, Marchigiani, & Bagnara, 1999). In terms of cognitive load theory, multimedia software with a poorly designed interface will increase the extraneous load on users and impede the processing of information in working memory, which in turn, contributes to cognitive overload.

Early studies on the effects of animation suggested that animation facilitated learning (Schwan & Riempp, 2004; Tversky, Morrison, & Betrancourt, 2002) because it facilitates the understanding of dynamic phenomena involving changes over time, which cannot be inferred from static graphics. However, more recent studies have noted that the impact of animation may be due to the additional information conveyed rather than the animation of the information per se (Betrancourt & Berney, 2012). Paik (2010) found that animations teaching relatively short human-movement tasks were found to be superior to equivalent static images. However when animations were used on longer tasks there was no improvement in performance. Paik (2010) also noted that the type of animation used (highlighting versus motion animation) affected performance with highlighting animation more effective. His findings support Mayer's (2002) cognitive load theory, which suggests that difficulty with longer tasks may have exceeded working memory limitations and placed too much cognitive load on the learner. However there is no consensus in the literature as to when a motion animation will benefit learning and when it will be detrimental to learning (Mayer, 2014). Betrancourt and Berney (2012) suggest that allowing the learner to control the pace of the information that is presented in an animation will reduce the memory load and facilitate

comprehension.

Smeets, van Dijken and Bus, (2014) tested the effects of several weeks' exposure to e-books on vocabulary learning. They found that even without adult co-reading, children with language impairment showed post-intervention improvements on a vocabulary test. Similarly, Vaala and Takeuchi (2012) explored parents' perceptions and practices surrounding co-reading with children on iPads. Parents felt that features such as hotspots and animations distracted their child from reading and highlighted text and audio narration were helpful. Interestingly, Smeets et al.'s findings indicate that, for children with more severe language impairments, the presence of background music and other sounds was counterproductive. This has implications for app design specifically in relation to Mayer's (2002) principles of multimedia learning, which were discussed earlier.

Pegrum, Howitt and Striepe (2013) emphasise that the wide range of devices, pedagogical approaches, content areas and levels considered makes it difficult to draw general conclusions, other than to say that mobile learning appears to have the potential to improve learning outcomes. Despite the scant empirical research on the benefits of using mobile technology, speech and language pathologists report that clinical practice is benefiting from the use of iPad technology (Sandvik, Smordal, & Osterud, 2012; Wakefield & Schaber, 2012).

Sandvik et al. (2012) conducted an exploratory study where they introduced iPads to typically developing 5-year-old children in an adult-led activity. Their findings showed that intervention, using iPad apps in a kindergarten population led to valuable activities for language learning and literacy practice. The authors hypothesise that the nature of the teacher's interaction was important in scaffolding the children's responses. Additionally, the authors felt that the portability of the iPad facilitated smooth turn taking, shared interaction

and peer support. Mayer and Moreno (2003) consider that the reason for this may be because the cognitive load is reduced and learning capacity improved when using interactive features of digital picture books.

Gonzalez and Fryer (2013) conducted a study to determine the effect of universally designed iPad application on the academic readiness and language skills of at-risk preschool students. The iPad apps used were selected using the Universal Design for Learning (UDL) framework (Rose & Meyer, 2000). This framework is guided by the three principles: Multiple means of representation to support recognition learning, multiple means of expression to support strategic learning and multiple means of engagement to support affective learning. Whilst the authors postulate that the iPad may be beneficial for at-risk pre-schoolers, the results of their study only demonstrated significant impact of intervention in the area of upper case letter knowledge. Gonzalez and Fryer (2013) point out that there may be specific characteristics of the applications that enhance or detract from learning and that a rating scale is needed in order to evaluate these features. It must be noted that although the researchers state that the classroom teacher introduced a new app from the 12 selected iPad apps every two weeks, there are no details about how the intervention occurred. It is possible that there was no teacher scaffolding for the 15-minute intervention sessions and the lack of scaffolding may have resulted in limited improvements in all areas.

In contrast, Falloon (2013) used embedded video to observe typically developing 5-year-old children's interaction with a variety of iPad apps, in an attempt to identify factors in the design and content features that affect learning. His findings highlighted a number of factors that should be considered when selecting apps for learning. These include the effect of embedded pedagogical scaffolds (e.g. modelling, reflection time), the type of feedback and some types of instructions. Factors that were impediments to learning included web-links,

pop-ups in the app and poor entertainment/education balance which allowed children to 'gamify' the app. In addition Falloon (2013) noted that some apps contained design parameters, which place a level of structure around students' interaction with content. For example imposing time limits on game-components resulted in better work-education balance. The ability to pre-set difficulty or content parameters (and how easily this can be done) facilitated better engagement at the students' level. Apps providing a clear learning goal, structure, guidance and well-defined parameters around interaction were most beneficial. Falloon (2013) found that the most effective of the supported learning apps closely resembled a traditional teaching model, often involving video of a real person teaching a particular skill. In addition, he noticed an increase of student responses whenever the teacher herself presented instructional supports, such as introducing the objectives with age appropriate language, providing and explaining examples, modelling, and reflection prompts. These findings highlight the importance of taking into consideration not only the design and content of apps but also the incorporation of the teacher/educator to facilitate learning if using devices such as the iPad is to be transformed into "thoughtful engagement and productive learning" (p. 519).

Cumming and Rodríguez (2013) examined academic engagement of four students with language-based disabilities during a language arts class. Although a paraprofessional was present during activities, her role was to prompt the students to return to the task in order to measure the level of engagement. The results showed that academic engagement increased within the first four sessions, but decreased towards the end of intervention. The authors hypothesise that this could be due to the students getting bored using the same application, the lack of feedback provided by the application itself and/or increased proficiency with the sentence formulation task (Cumming & Rodríguez, 2013). It is also possible, that reliance on the app for feedback rather than obtaining feedback from the paraprofessional could have

contributed to the decreased engagement. The authors note that providing students with a few reinforcing games or a variety of apps to teach the same skill may reduce boredom.

Research supporting teacher-mediated intervention when using apps comes from Sandevik, Smordal and Osterud (2012). They examined the types of talk, engagement and playfulness in 5-year old children in a multicultural kindergarten. They found positive support for the use of iPad apps when the teacher scaffolded the children's understanding by providing contextual clues. When the children's engagement and participation was guided by the teacher their verbal and non-verbal responses increased and they were able to connect the technology to real world contexts. In addition, peer support was extensive and they made use of verbal strategies. Good turn-taking skills were also noted.

Shane (2011) emphasizes that clinicians do not need a whole new paradigm for language intervention using apps. He states that iPads represent the intervention materials of the future, which are in an electronic format instead of having to use traditional therapy tools such as pictures. Sutton (personal communication, April 2015) states that technology for therapy does not replace the therapist or the need for an individualised assessment and treatment plan, but it can help people improve faster by getting more practice. Gosnell et al., (2011) state that clinicians need to learn and challenge themselves to develop more engaging and relevant intervention strategies. To this end, clinicians need to make informed decisions about which apps to use.

Clark and Feldon (2005) emphasise that it is important to consider the instructional methods that can be embedded into the presentation of multimedia learning. Therefore, in order to identify features that are the important in a language app, it is necessary to identify which features of language instruction are used. Additionally, there needs to be an alignment between technological integration practice and pedagogical beliefs for effective learning to

occur (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Ting (2012) states that understanding the pedagogical perspective in mobile app selection translates into the use of a mobile app for more than its technological functions.

Language and learning are inextricably linked and there is extensive research on the relationship of language abilities and future academic success. The following section examines these areas.

2.5 Learning Theory

Learning theories are broadly categorised into three types; behaviourist, cognitive constructivist, and social constructivist. Driscoll (2000) defines learning as "a persisting change in human performance or performance potential which must come about as a result of the learner's experience and interaction with the world" (p.11). In order to facilitate learning in any environment, a number of elements must be considered: (a) Learner-centred learning: This refers to the pre-existing knowledge that is brought into the learning environment (Anderson, 2004; Bransford, Brown, & Cocking, 2000). (b) Active and meaningful learning: Learning tasks need to be perceived as relevant to students and connected to the world and their own reality. Therefore tasks should be based on real-world problems, and organized around subjects that will promote intellectual, cognitive, and emotional engagement (Anderson, 2004; Bransford, Brown & Cocking, 2000; Fadel & Lemke, 2008). (c) Metacognition: This refers to the ability to develop awareness about their learning process and learning content. Metacognition requires the student to self-monitor and become aware of their strengths and weaknesses. Given appropriate scaffolding by educators and other adults, all students can learn metacognitive strategies (Bransford, Brown, & Cocking, 2000; Fadel & Lemke, 2008). Although emergent learning theories differ in some aspects, they share an emphasis on considering children as active agents of their learning, who are able to set goals,

carry them out, and assess and regulate their learning.

Anderson (2004) points out that the current learning theories were developed in a time when learning was not impacted through technology. Thus, despite early views (Clark, 1983; Salomon, 1979) that learning is dependent on the instructional methods used, more recent advances have shown that multi-modal learning is more effective than traditional, uni-modal learning (Fadel & Lemke, 2008). Therefore, Pellerin (2014) states that our increasing knowledge about the complexity of the nature of learning and the various factors that influence it, means that it would be remiss not to include a variety of modalities to promote multi-modal learning.

Kearney, Schuck, Burden, and Aubusson (2012), and Wang and Reeves (2003), suggest that social- constructivist learning theory developed by Vygotsky, in which social and individual processes are interdependent in the construction of knowledge, should be adopted for mobile learning (m-learning). Accordingly, learning is affected and modified by the tools used for learning, and that the learning tools reconstruct and reorganise our thinking and behaviour by the ways that they are used for learning (Kearney et al, 2012). Thatcher and Mooney (2008) emphasise that central to Vygotsky's ideas is that the tool alters the process of how one responds to the task. Therefore, if two individuals used two different tools in order to solve the same problem, then their responses to the same task would be qualitatively different. The implications of this when adopting the use of apps for intervention are potentially significant, since one would need to evaluate whether intervention using traditional therapy tools or apps are more effective. Additionally, in examining the tools and the specific ingredients used, the mechanisms of action that facilitate change on the target could be inferred.

Duckworth (1979) emphasises that it is important to take into account what Piaget and Vygotsky termed 'the struggle of learning.' In Piagetian terms the learner 'struggles' to absorb and 'assimilate' dissonant information into existing mental models (schemata) and the resulting cognitive uncertainty (disequilibrium) results in modification (accommodation) of previous understanding. Hirsh-Pasek et al. (2015) state that research suggests that children learn best when they are cognitively active and engaged, when learning experiences are meaningful and socially interactive, and when learning is guided by a specific goal. It may be posited that the use of apps facilities active engagement and optimal learning potential.

The role that technology has in learning is still not definitive. The use of technology alone does not necessarily make a difference to learning. The rapid advances and changes in technology since the development of the iPad has meant that there is little to guide clinicians, from a theoretical perspective, with regard to implementing technology into practice.

2.6 Language Disorder

Language disorder[4] is one of the most common types of difficulties associated with special educational needs (Lindsay & Strand, 2016). However language disorders are heterogeneous and may be idiopathic or occur co-morbidly with socio-economic difficulties and/or other developmental disorders such as intellectual impairment, ASD, and neurological impairment. In addition, the complex and multifaceted nature of language contributes to difficulties identifying and categorising language disorders (Bishop, Snowling, Thompson, & Greenhaigh, 2016).

[4] DSM 5 (2013) classifies a language disorder as persistent difficulties in the acquisition and use of language across modalities (i.e., spoken, written, sign language, or other) due to deficits in comprehension or production and language abilities that are "substantially and quantifiably" below age expectations

In spite of the prolific number of theories of language development, there is no agreement in the literature of a functional theory of language development. Nevertheless, language development is not haphazard and occurs systematically and predictably; – although there is a great deal of individual variation that reflects underlying language-learning strategies, linguistic complexity and cognitive growth (Owens, 2015).

In their classic work, Bloom and Lahey (1978) suggest that the notion of language learning involves interactions among the three components of language: form, content, and use. Secondly linguistic behaviour must be considered and not the aetiology or correlates of the language disorder. Information of normal language development must serve as the basis for the sequence of the goals of intervention and finally, the goal must be language production with language comprehension an implicit goal. An interactionist approach to language development focuses not only on the structures and mechanisms internal to the child, but also on the powerful influence that experiential and social factors have with unobservable mental faculties. Assessment based on this thinking leads to more holistic intervention goals and procedures, as the interrelationship between and among the developmental components is recognized and the use of developmental sequences and processes is prioritized (Gerber, 2003).

Although there is no single mechanism that can be attributed to language disorders, it is postulated that children with language disorders have difficulty with the way they process auditory and visual information, and represent the information as a cognitive process (Gillam, Hoffman, Marler, &Wynn-Darcy, 2002). Thus difficulty in one area may affect processing in the other. Consequently children with language disorders experience more difficulty as the demands of the task increase.

2.7 Language Intervention with Children with Language Disorders

The purpose of any developmental intervention is to accelerate, or redirect the course of learning (Johnston, 1985). Although a direct teaching explanation of language intervention is inadequate there are numerous intervention strategies cited in the literature that are empirically justified. The type of intervention may be guided by the theoretical stance adopted by the SLP but there is no unified theory of rehabilitation (Whyte et al., 2014). In addition to overt language difficulties, contemporary approaches to language intervention include expanding language intervention goals to pre-linguistic and non-linguistic domains of communication. This includes addressing pragmatic skills as potential targets of therapy and allows SLPs to more accurately address the nature of many children's language and communication impairments (Gerber & Wankoff, 2010).

There are a number of different intervention strategies that have been specified and there is a general consensus on the basic principles and procedures of language therapy (Bloom & Lahey, 1978; Fey, Long, & Finestack, 2003). Roth and Worthington (2015) emphasise that in order to make therapy sessions more efficient, therapy sessions should be designed to provide the child with the maximum number of opportunities to practice target behaviours.

2.7.1 Scaffolding. The use of scaffolding underpins many of the intervention approaches. Scaffolding refers to situations in which the learner gets assistance or support to perform a task beyond his or her own reach if pursued independently when "unassisted" (Wood, Bruner, & Ross, 1976, p.90). Knowledge, skills and prior experiences, which come from an individual's general knowledge, create the foundation of scaffolding for potential development. At this stage, students interact with adults and/or peers to accomplish a task that could possibly not be completed independently. The use of language and shared

experience is essential to successfully implementing scaffolding as a learning tool (Berk & Winsler, 1995). Wood et al. (1976) used the term 'scaffolding' to describe the nature of parental tutoring in the language development of young children. Hammond and Gibbons (2001) note that a major feature of scaffolding is the ability to identify a child's current level of understanding and through problem solving and collaboration, extend the child's levels of understanding. In addition scaffolding is temporary and support is gradually faded so that the child can learn independently.

2.7.2 Modelling. Kamhi (2014) states that one of the most important components of therapy is the language model provided by the clinician to the client. Modelling is procedure in which the SLP produces a rule-governed utterance at appropriate junctures in conversation. Modelling has been shown by a number of researchers to be an effective technique in facilitating the use of certain language structures (Cleave & Fey, 1997; Courtright & Courtright, 1979). Modelling can be clinician-directed focused stimulation (mass practice) or child-directed which would consist of recasts and expansions of child-initiated language (Kamhi, 2014).

2.7.3 Recasting. Recasting or expansion is a method used for contrasting the child's current form with the target form. Recasts maintain the meaning of the child's utterance while modifying the structure. The use of recasting has been shown to be effective because it is similar to the child's original utterance and therefore easier for the child to notice the target features that distinguish the recast from the target (Camarata, Nelson, & Camarata, 1994; Fey, Long, & Finestack, 2003; Law, 1997).

2.7.4 Imitation. Elicited imitation is used to contrast linguistic elements and to highlight the relationship between form and function for children with language impairments (Cleave & Fey, 1997). Fey et al. (2003) emphasise that imitation is not a means to learn

language, but rather it is "an effective mechanism that can ensure the child's attention to and production of grammatical features that may be difficult for the child to perceive and/or produce" (p. 11). Whilst there is debate in the literature on the value of using imitation as a technique (Camarata et al., 1994), the literature lacks sufficient empirical evidence in order to exclude it as a technique (Fey et al, 2003; Smith-Lock, Leitão, Lambert, & Nickels, 2013).

2.7.5 Focused stimulation. Focused stimulation is a technique used to target a particular word, phrase, or grammatical form, and to use it repeatedly while interacting with the child (Fey, Cleave, Long, & Hughes, 1993; Girolametto, Pearce, & Weitzman 1996). This is done in a naturalistic setting. The object is to provide the child with opportunities to produce the target on their own. There is clear evidence for the use of focused stimulation on word learning, but there is still debate on whether to use simplified input or more natural input that attaches the relevant forms along with the target words (van Kleek et al., 2010; Wolf & Heilmann, 2010).

2.7.6 Direct instruction. Warren and Yoder (1994) report that direct teaching or didactic instruction has also been shown to be an effective approach in some instances. This approach is characterized by the use of specific prompts and reinforcement, rapid massed trial instruction and the use of task analysis to break the targeted skill down into small, easily learned parts. Cole, Dale, and Mills, (1991) report that direct instruction is most effective when teaching abstract and/or specific skills. A recent study by Good, Lance, and Rainey (2014) showed that explicit teaching of morphological structure of words resulted in greater gains in the experimental group than in the control group in literacy and language skills of children with language impairment. Hicks, Rivera, and Wood (2015) showed that direct instruction was effective in teaching prepositions to children with intellectual disability.

2.7.7 Milieu language teaching. Kaiser (1993) proposed Milieu Language Teaching

as an intervention approach aimed at enhancing caregiver-child social/communicative interactions in the natural environment. Hancock and Kaiser (2006) further delineated the technique to include a combination of strategies. These strategies include (a) feedback that is based on the child's effort and achievements, (b) modelling language targets in descriptive talk, (c) expansions, (d) balanced turn-taking, (e) eliciting models, (f) mands/requesting, (g) time delay, and (h) incidental teaching. (Hancock & Kaiser, 2006 cited by Parker-McGowan et al., 2014).

2.8 Considerations for Language Learning and Apps

Fadel and Lemke (2008) emphasize that optimizing learning for each student requires more fine-grained differentiation of instruction that takes into account and leverages how the brain functions, how people learn, and multimedia design. Accordingly, effective learning should consider the circumstances in which learning takes place, the level of interaction of the learner, the unique characteristics of the learner, and a combination of learning modalities – including different types of media. However, to date, there is a marked paucity in the literature that examines the complex array of potential ingredients that may impact on language learning when using apps. Features that have been identified include engagement, distraction, feedback, reward, and social interaction. In addition, there are a number of factors that are important for successful intervention. These are discussed below.

2.8.1 Engagement. Central to intervention is the notion of engagement. Bloom and Tinker (2001) explain engagement as the social and emotional motivation for learning language. Infants can participate in organized meaningful exchanges without words long before language. This is important for SLPs when determining the language goals to address. There is evidence that typically developing children demonstrate increased levels of

engagement when using iPads for learning (Chou, Block, & Jesness, 2012; Hutchinson, Beschorner, & Schmidt-Crawford, 2012; Reyes, 2014). Since children with language difficulties may require more time on a task as well as regular and intensive intervention, it is important to evaluate whether learning with iPads promotes increased engagement in this population.

The speech-language pathology literature on engagement generally comes from the field of autism where difficulties with joint attention and engagement are of concern (Adamson, Bakeman, Deckner, & Romski, 2009; Hourcade et al., 2013; Neely et al., 2012). These studies found that using tablet technology promoted engagement and facilitated positive therapeutic outcomes.

In students with intellectual disability, Rivera, Spooner, Wood, and Hicks, (2013) demonstrated that the use of technology paired with prompting strategies facilitated learning of vocabulary. Wouters, van Nimwegen, van Oostendorp, and van der Spek (2013) demonstrated that when computer games were used to supplement other instruction methods, both learning and retention improved. Numerous studies suggest that students with disabilities need to be engaged in several ways before new information is learned and difficulties with engagement and motivation play a pivotal role in acquiring and using language (Eisenberg, 2013; Mundy, Sigman, & Kosari, 1990; Powell, Burchinal, File, & Kontos, 2008; Rivera et al., 2013; Tomasello & Farrar, 1986).

2.8.2 Distraction. Linked to engagement is the contrasting notion of distraction. Parish-Morris, Mahajan, Hirsh-Pasek, Golinkoff, and Collins (2013) found that the "bells and whistles" embedded in an e-book often distracted 3-year-olds from understanding and remembering the story. Recent studies found that for children with language impairments, the presence of background music and other sounds was counterproductive in using book

apps for intervention (Smeets, van Dijken, & Bus, 2014; Takacs, Swart, & Bus, 2015). The authors suggest that competing auditory information may impede attention to language. Children with language impairments may be particularly susceptible to distraction because of their linguistic deficits and difficulty inhibiting extraneous information (Vissers, Koolen, Hermans, Scheper, & Knoors, 2015). This highlights the importance of creating apps that allow settings to be adjusted so that considerations of multi-media learning can be incorporated into the app and tailored to meet the learning requirements of the child.

2.8.3 Feedback. Johnson, Priest-Walker, Durlach, and Serge (2012) and Johnson and Priest (2014) note that not only is feedback a significant factor in facilitating learning, but also, the type of feedback that is received, is important. In the former study, participants who were provided with detailed feedback resulted in the most improved performance. In multimedia environments, explanatory feedback (informing the learner why an answer is correct or incorrect) has often been compared with corrective feedback (indicating correct or incorrect only), where the former is superior. A study by Gunderson et al. (2013) showed that children who hear a greater proportion of person praise (e.g., "you're so smart") may come to believe that the sources of their accomplishments are fixed traits and children are less likely to persevere when faced with difficulties. Children who hear a greater proportion of process praise (e.g., "you worked hard") tend to believe that their accomplishments are based on effort and deliberate practice and this motivates them to persevere with difficult tasks later on. Muis, Ranelluci, Trevors, and Duffy (2015) conducted two studies to examine the effects of feedback in preschool children using iPad apps for literacy development. Whilst the precise nature of feedback was not outlined, their results showed that the children enjoyed receiving positive feedback, but did not like receiving negative feedback for incorrect responses. The researchers noted that technology-mediated feedback resulted in higher levels of achievement compared to when no feedback was provided, although the levels of

enjoyment differed in the two groups. Clearly, feedback is an important part of the learning process and SLPs using apps for intervention should be mindful of the type of feedback provided by the app and adjust their responses or modify settings accordingly.

2.8.4 Reward. Children's engagement in a structured system of learning and feedback is typically driven by extrinsic motivation (Deci, Koestner, & Ryan 1999). Rewards and incentives are often used in apps in order to motivate the child. Clinicians use multiple trials and activities, which are scaffolded to match the level of the client (Folkins, Brackenbury, Krause, & Haviland, 2016). This is used in order to ultimately encourage deeper understanding and intrinsic motivation related to improved communicative success. The literature that shows that external rewards are particularly beneficial to increase motivation and performance on tasks that are of low initial interest (Cameron, Banko, & Pierce, 2001; Filsecker & Hickey, 2014; Lepper, 1998). Children who have difficulty with a task may lack motivation and therefore providing extrinsic rewards may encourage them to persevere with the task. Therefore despite the fact behaviourist theories have been widely discounted as contributing to language and learning, the principles of reinforcement and reward increases the probability that the behaviour will occur and is part of any therapeutic intervention (Kaderavik, 2011; Smith-Lock et al., 2013). The fact that many apps that are used for language intervention have built in rewards, may facilitate engagement, motivation and on task behaviour.

2.8.5 Social Interaction. Social-interaction and context have been widely cited in the literature as being critical to language learning (Bruner, 1977; Bloom & Lahey, 1978; Hoff, 2006; Kuhl, 2007; Snow, 1989, Vygotsky, 1978). Context refers to the combined physical, information and social setting of learning, which for mobile learning in particular is in continual change (Taylor, Sharples, O'Malley, Vavoula, & Waycott, 2006). Hirsh-Pasek et

al. (2015) feel that apps can incorporate social interaction by encouraging collaboration, turn-taking, shared experience of viewing and discussion and prompts for conversation. However, despite the fact that apps are extremely responsive they cannot replace real world social interaction. Therefore, it is the role of the SLP to tailor feedback and facilitate interaction based on their awareness of the child's developmental level, knowledge, experience and interests.

Language learning and information processing are dynamically related. (Gillam, Hoffman, Marler, &Wynn-Darcy, 2002; Snyder, Dabasinskas, O'Connor, 2002). The use of apps may serve as an important source of reducing the processing load to support language development. In doing so, intervention should concern "form, meaning and use interactions in pragmatically relevant contexts" (Gillam et al., 2002 p. 43).

One of the challenges facing clinicians when addressing language goals is that the demands of the non-linguistic and linguistic context give rise to the form and content of the language expressed (Bloom & Lahey, 1978). However, many linguistic targets may be difficult to address because they do not occur frequently in typical clinical settings (Fey, Long, & Finestack, 2003). The role of the SLP is to learn to manipulate contexts to provide a child with the maximum learning possible (Owens, 2010). This approach must be considered together with the child's functional readiness and need for the targeted forms (Fey, Long, & Finestack, 2003). Primavera, Wiederlight, and DiGiacomo (2001) demonstrated that children who had daily access to a large library of educational software and teacher supervision made gains, but those with a weekly session with a mentor who facilitated use of the technology made even greater gains. This highlights the importance of mediation when using technology for learning.

2.9 Apps and Evidence-Based Practice

One of the core components of EBP is research evidence on the effectiveness of language intervention. There have been a number of ways in which the effectiveness of language intervention has been demonstrated. Some studies have evaluated specific intervention techniques (Cleave, Becker, Curran, Van Horne, & Fey, 2015; Ebbels, 2014), while others have provided broader literature reviews (Cirrin & Gillam, 2008; Law, Garrett & Nye, 2004). The efficacy of different intervention strategies has been a source of on-going debate in the literature. In addition, it is not possible to identify a set of treatment techniques in a field that is grounded in individualization and which is matched to the unique needs of the child (Schwartz, Carta, & Grant, 1996). Nevertheless, the evidence is equivocal in that some studies found child-led interactions more effective (Smith-Lock et al., 2013; Yoder, Kaiser & Alpert, 1991), whilst others found a more didactic approach more effective (Good et al., 2014). Law, Garret, and Nye (2004) emphasize that irrespective of the approach used, these debates all conclude that language intervention is effective. A combination of techniques is often needed (Fey et al., 1993; Law, 1997; Eisenberg, 2013), taking the context of learning into account (Schwartz et al., 1996).

The second component of EBP, clinical judgement, is less well defined. Gillam and Gillam (2006) note that the paucity of evidence of beneficial language intervention practices for school-age children with language disorders means that SLP's need to continue to rely on their own judgements and the needs of the client more than external research. In a field of intervention such as speech-language intervention with children who present with language disorders, clinicians depend to a large extent on their clinical judgement. However, there are still some misconceptions about the value and meaning of clinical judgement. Relating the issue to medical services provided in India, Karthikeyan and Pais (2010) state that clinical

judgement involves the "appropriate application of knowledge and individual expertise to the problem at hand" (p. 623). Whilst the authors note that the clinician's ability to apply and integrate available evidence with the patient's needs may be complex, this does not imply that EBP and clinical judgement are two distinct entities.

In order to employ clinical judgement to identify the criteria for app selection, the approach to intervention should be functional and eclectic (Rodríguez, Strnadová, & Cumming, 2015). Taking a functional approach focuses on children's language from a holistic perspective (Owens, 2010). Accordingly the SLP needs to be mindful of certain principles that aid communication and learning for a child whilst ensuring that the communication is meaningful so that new information is generalised. Therefore when examining the criteria for app selection, they must support the principles of developmental sequence, context and approaches to intervention. In addition, the principles of multimedia learning should be considered.

Gosnell (2011) emphasises that traditional language therapy approaches can still be targeted through the use of apps. Lee and Cherner (2015) caution that apps should be considered as a resource that is implemented with the support of an educator. Clark (1983) noted in his meta-analysis studies on media research that students gain significant learning benefits from audio-visual or computer media, as opposed to conventional instruction; however, the same studies also suggest that the reason for those benefits is not the medium of instruction, but the instructional strategies built into the learning materials. Jacobsen, Clifford, and Friesen (2002) describe a critical enquiry based approach to the use of technology in learning. They emphasize the importance of empowering educators and focus on the task rather than on the technology.

As can be seen there are a number of factors that must be considered in order to

provide effective language intervention. The aim of this research is not to choose an approach, but rather to highlight the factors that clinicians, using their clinical judgement use when selecting apps for intervention. Cubelic and Larwin (2014) note that the successful implementation of technology is complex. The challenge to clinicians is to select an app based on evidence-based practice and to incorporate clinical decisions based on the needs of the client (Gosnell et al., 2011; Wakefield & Schaber, 2012).

2.10 Summary of the Literature Review

There is limited literature on using apps for language intervention with children in the field of speech-language pathology. However it is apparent that SLPs are using technology in their language intervention. The manner in which they are using this technology has not been explored but it has been suggested that SLPs do not need to adopt new paradigms when using apps for language intervention. Nevertheless, there are a number of factors that should be considered when using apps for intervention.

Whilst multimodal learning has been shown to be more effective than a single manner of learning, the manner in which visuals and text complement or detract from learning must be considered. Mayer's (2003) theory of multimedia learning identifies principles that reduce the extraneous cognitive load and the demands on working memory. Touch screen devices have been shown to be intrinsically engaging for children, which in turn, facilitates learning. However, factors such as the interface design of the screen, animation and background noise can also impact on learning. Additionally, mediation by an educator when using an app results in more positive learning outcomes.

Learning theories and language intervention principles provide an important foundation on which to incorporate the use of apps for language intervention and it is

therefore important to determine the role that they play in the selection and use of apps

Whilst there have been numerous attempts to evaluate educational apps in order to investigate their efficacy, there is no consensus on how to do this. Within the field of speech-language pathology there is a need to incorporate EBP into clinical intervention. However, this is often not the primary means that practitioners use to guide their treatment selection (Lof, 2011).

Chapter 3: Methodology

This study is an explanatory, sequential mixed methods study to investigate the factors that SLPs deem as germane when selecting and using apps for language therapy with children. The study used questionnaires and interviews in two distinct phases (Creswell & Plano-Clark, 2011). The rationale for choosing a combination of quantitative and qualitative research methods is that they "complement each other and allow for a more complete analysis of the research problem" (Creswell & Plano-Clark, 2006, p. 280). The questionnaire was distributed online to an international population of SLPs using Survey Monkey. Follow up interviews with participants were also conducted online. The explanatory research design enables the use of qualitative data as a means to explain quantitative findings, in which a broad level understanding or big picture of the research problem has been obtained (Creswell & Plano-Clark, 2006).

3.1 Aims

The aim of this study was to identify features of apps that SLPs identify as germane when using an app for language therapy with children. In order to answer this question the following research question was devised:

Which features of apps do SLPs regard as important when selecting and using apps for language intervention with children?

The following sub-aims were devised in order to assist in obtaining information for the above-mentioned aim:

- What are some of the reasons why SLPs have adopted the use of apps in their therapy?
- How are SLPs selecting apps for language intervention?

- How are SLPs incorporating the use of apps into their therapy?

3.2 Design

The advent of the Internet and computer-mediated communication technologies means that research need not be geographically bound (Boyd, 2009). Netnography is a contemporary interpretive method that has been developed specifically to use source data online, and has been used predominantly to identify and understand the needs and decision influences of relevant online consumer groups (Kozinets, 2002). There are a number of formats that are used for online data collection (Creswell, 2014) including virtual focus groups and web-based interviews. Importantly, online data collection offers an alternative for hard to reach groups, due to practical constraints (Baltar & Brunet, 2012; James & Busher 2007). Christensen and Knezek (2008) emphasise that online data acquisition allow large amounts of data to be collected. Computer assisted self-administered questionnaires produce a higher response rate than other types of surveys (De Leeuw et al., 1998 cited by Wilkinson & Birmingham, 2003).

The current study is immersed in a netnographical approach, and employed an explanatory sequential mixed methods design using questionnaires and interviews in two distinct phases (Creswell & Plano Clark, 2011). The data obtained was quantitative and qualitative. Gillham (2008) states that questionnaires are rarely sufficient as a research method on their own and therefore using a combination of methods provides a more complete picture. Quantitative and qualitative research methods "complement each other and allow for a more complete understanding of the research problem" (Creswell & Plano Clark, 2011, p. 8). A mixed methods approach aids in the description and development of procedures and tools that more closely resemble those used by educational practitioners (Onwuegbuzie &

Leech, 2004). The survey was cross-sectional survey. That is, the data was only collected once and not over a period of time (Stoop & Harrison, 2012).

3.3 Participants

Participants in the study were a sample of SLPs who reported to make use of apps in their work with children who are language impaired. The sample was selected, as these are the professionals who are using speech and language apps and are likely to contribute to selecting and recommending apps for intervention.

Since the literature has revealed that SLPs are obtaining insight into which apps to purchase based on word-of-mouth and online information (Gosnell et al., 2011; Hennig, 2014), this community was sourced using an online questionnaire. The Internet is an important source of information when targeting certain groups of professionals for which comprehensive lists are available. Since app users are likely to be computer users, a web-based survey is likely to resonate with their technological preferences. Dillman, Smyth, and Christian (2014) suggest that using large sample sizes will enable more precise information to be obtained about specific subgroups.

The survey used a purposive sample from the population of interest, namely speech-language pathologists who reported that they were using apps in therapy. Thereafter, network sampling was used and members of the initial sample were asked to provide contact information for additional members of the target population or to forward the survey to others in their network (Hibberts, Burke, Johnson, & Hudson, 2012). Recruitment of participants is discussed further on in this chapter. The sample used was a respondent driven non-probability sample based on the opinions and knowledge of SLPs using apps. Accordingly, the researcher uses subjective judgment, drawing on theory (i.e., the academic literature) and

practice to select the sample (Laerd Dissertation, 2012). The use of network sampling allowed the researcher to investigate a more representative sample of hard to reach target population (Balter & Brunet, 2012).

Sample size considerations were based on the key research questions, namely the estimation of proportions. The estimation of a 50% proportion (worst-case in terms of sample size) at the 95% confidence level with a precision of 5%, requires a sample size of 385. The actual sample size of 338 (for the bulk of the study) corresponds to a precision of 5.3% which is acceptable for this type of study.

Sample size for proportions was determined using the formula:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

n = sample size,

Z = Z-statistic for the chosen level of confidence,

P = expected prevalence or proportion

d = precision

(Daniel, 1999)

3.4 Inclusionary Criteria

Participants were obtained by contacting SLP organisations in order to distribute the survey. The following organisations were contacted: The South African Speech Language and Hearing Association (SASLHA), the Royal College of Speech and Language Therapists (RCSLT) in the United Kingdom, the Canadian Association of Speech Language Pathologists (CASLPA), the American Speech-Language-Hearing Association (ASHA), Speech Pathology Australia (SPA) and the New-Zealand Speech-language Therapists Association

(NZSTA). All participants were required to be English-speaking. The interviews and survey were developed in English. In addition, almost all apps are developed for English speakers.

1. In addition to South African SLPs where the research originates, the target sample comprised SLPs from five other predominantly English-speaking countries. Specifically, the countries that were included are; Australia, New Zealand, the United States of America (USA), Canada and the United Kingdom (UK). SLPs in these countries report using apps and since network sampling was used it is likely that the questionnaire will be disseminated to SLPs in these countries.
2. An international survey is called for, for the following reasons:
    a) Any research project is dependent on access to sufficient data to address the research question(s) of interest. Although limited data are available, in my personal and professional interaction with therapists in South Africa, there is limited scope of experience using apps. Dillman et al. (2014) state that it is important not to overburden respondents with questions that they cannot provide accurate answers to as this results in decreased response and lower data quality.
    b) Technology allows data to be captured from all over the world and therefore use of an international sample could result in a more extensive sample size.
    c) An international sample may facilitate evidence-based practice (EBP) in the field of speech pathology. Sackett, Rosenberg, Gray, Haynes, and Richardson (1996) in their paper on evidence based practice in medicine, state that evidence should never prevail over the individual expertise of the clinician. It is therefore important to consider the expertise of as many clinicians as possible in order to guide evidence-based practice.
    d) Although SLP practices vary somewhat in different countries, there is consistency in the literature in terms of clinical interventions used. Therefore it is important to obtain

the perspectives of an international sample of clinicians (Pickering & McAllister, 2000).

e) Cultural and contextual differences and difficulties worldwide have been noted in the literature, and therefore if SLPs have access to iPads in these communities, valuable insight may be gained from their contribution.

3. All participants were required to have experience using apps in their clinical work. The focus of their practice was expected to be primarily paediatric. There is literature from a number of studies that cite using expert opinion in order to obtain data relevant to clinical practice (Acevedo et al., 2014; Schiariti et al., 2013). In order to obtain information regarding app features, it is necessary to obtain information from SLPs that use apps.

3.5 Exclusionary Criteria

1. SLPs who do not practice as speech-language pathologists e.g. audiologists were excluded.
2. SLPs who are also app developers or who have authored apps for developers were excluded. It is highly likely that SLPs who are app developers will favour their designs and this will bias the responses.
3. SLPs who do not work with a paediatric language impaired population were excluded.
4. SLPs who do not provide therapy in English were excluded since the survey was developed in English and questions related to apps developed in English.
5. SLPs who do not use apps developed for speech-language therapy were excluded as their naivety with apps may influence their responses.

3.6 Method

The research comprised two phases that are outlined in Figure 3.

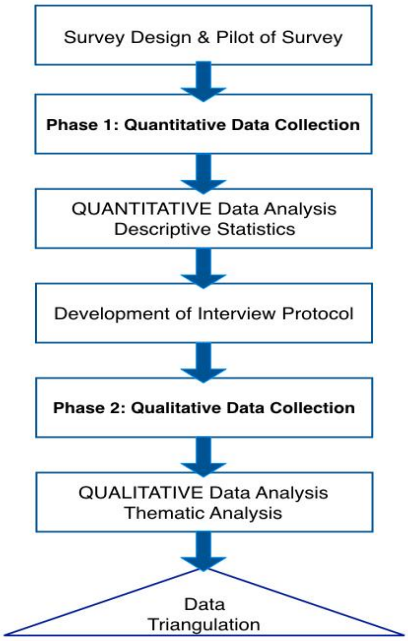


Figure 1. Outline of Mixed Method Research (Adapted from Creswell & Plano-Clark, 2011)

3.7 Web Based Survey

3.7.1 First phase. A self-developed survey was developed for the first phase of quantitative data collection. The researcher, in line with the objectives of this study, developed the survey.

Surveys, according to McMillan and Schumacher (2001, p. 602), are an "assessment of the current status, opinions, beliefs, and attitudes by questionnaires or interviews from a known population" which enables the measurement of the distribution and patterns of collected data.

Surveys can be designed and used to collect vast quantities of data from a variety of respondents. Some of the benefits of surveys are that they can be inexpensive to administer and they can be analysed quickly and easily once completed (Wilkinson & Birmingham, 2003).

One of the weaknesses of surveys is that the researcher determines the questions and all the possible answers in advance. This reduces the element of discovery of new information. It also does not allow the researcher to explore the reason behind selected responses (Gillham, 2008). Therefore, in order to obtain more in-depth information, a qualitative interview was used to complement the data obtained from the questionnaire.

Low response rate is also a weakness of Internet surveys (Monroe & Adams, 2012). However, computer assisted self-administered questionnaires produce a higher response rate than other types of surveys (De Leeuw et al., 1998 cited by Wilkinson & Birmingham, 2003).

3.7.2 Development of the survey. Previous attempts identifying criteria for evaluating an app have used theoretical frameworks (Lee & Cherner, 2015) or criteria identified by the researchers as important (Boyd, Barnett, & More, 2015; Martin-Monjrús, Arús-Hita, Rodríguez-Arancón, & Calle-Martínez 2013; Ok, Kim, Kang, & Bryant, 2016; Walker, 2010). However, to date, there is limited research that includes the perspective of the professionals' together with the theoretical underpinnings. Frameworks that have focused specifically on apps for SLPs are also lacking. Therefore, in order to obtain the perspective of clinicians, the questionnaire was designed based on the theoretical underpinnings of language intervention as well as the principles of multimedia learning as these factors have been shown to facilitate learning (Weng & Taber-Doughty, 2015).

The survey (Appendix A) is divided into four sections. The first section contains demographic information regarding geographical location, years of clinical experience and clinical population that the SLPs work with. This section also obtains information about clinical experience using apps and the extent of this use. The second section relates to intervention techniques, content of the app and the type of feedback provided. The third section relates to the design of the app. These questions were formulated in accordance with principles of multi-media learning (Mayer, 2002). Finally, information regarding training using technology is included as the literature regarding the adoption of technology suggests that factors such as support and training are fundamental to the successful adoption of technology (Buabeng-Andoh, 2012).

Henninger and Sung (2012) report that close-ended questions are the preferred format for most researchers because they provide response choices and limit the amount of interpretation inherent to open-ended questions. This allows analytic categories to emerge. However, in order to expand on themes that emerge, some open-ended questions were also included. Henniger and Sung (2012) report that open-ended questions can be advantageous because the researcher may be provided with answers that had not occurred to them.

The questions used construct-specific options as these reduce acquiescence, response bias and cognitive burden. These allow respondents to map their judgments to the response options and results in less measurement error (i.e. higher reliability and validity) (Dillman, Smyth, & Christian, 2014). In addition, it is important to minimize the time that respondents spend completing the survey. The time taken to complete the survey was approximately 10 minutes. Providing response options also enabled the researcher to track responses more easily (Lauer, McCloud, & Blythe, 2013).

For the purposes of this research, a paid monthly account of Survey Monkey was used. Survey Monkey is a user-friendly online survey tool that tabulates data and can provide a statistical breakdown of results (Massat, McKay, & Moses, 2009). This tool enables a convenient, expeditious way to compile results instantaneously (Buchanan & Hvizdak, 2009). Survey Monkey was selected because of the following features:

1. Design flexibility. The programme offers a number of different templates that can be used. In addition it offers mobile optimization and mobile app support. Since the current literature reflects that respondents are using mobile phones and tablets to access the Internet, it is important that the survey can be accessed in this manner without changes to the visual layout (Dillman et al., 2014).
2. Control of data. Data are protected with secure servers.
3. Data access. Depending on the profile selected, analytics are provided.

Dillman et al.'s (2014) tailored design approach to survey methods was adopted as a framework for developing and implementing the survey. Tailored design refers to "fitting the communication and response modes to the survey topic, population characteristics and the implementation situation one faces" (Dillman et al., 2014, p. 28). This involves using different aspects of the survey request to work together in order to encourage a response.

3.8 Reliability and Validity of the Survey

The survey was distributed using an online survey tool surveymonkey.com. Therefore, respondents had the same questions, in the same order with the same formatting. In doing this, differences in answers may be attributed to the varying attitudes and beliefs of respondents, rather than differences in the questionnaire (Henninger & Sung, 2012).

Internal validity refers to the degree to which the research instrument accurately

measures what it is meant to measure (Creswell & Plano Clark 2011). Henninger and Sung (2012) state that surveys should be pre-tested by providing them to friends/colleagues in order to pick up any potential problems.

The survey was evaluated by three SLPs who fitted the inclusionary criteria. A cognitive interview was used in order to identify any issues regarding suitability and clarity (Dillman et al., 2014; Gillham, 2008; Wilkinson & Birmingham, 2003.) The cognitive interview was conducted online using FaceTime with each of the participants and the participants filled out the survey in the presence of the interviewer. The three SLPs were recruited via social network groups on Facebook. This recruitment strategy yielded one participant from the USA, one from the UK and one from Australia. The interviews were recorded on an Olympus digital voice recorder (DS-30) and transcribed verbatim. Their responses were not included in the final data analysis. Only one change was made to the survey following the cognitive interviews. This related to work settings in the UK. This approach was used in order to limit inappropriate conclusions being reached (Dillman et al., 2014).

In order to control for extraneous variation, the sample population of SLPs have been identified as adopting similar practices and behaviours even though they represent an international population (Sekaran, 1983). The benefits of using an international web based survey were considered in the context of the external validity. The ability to distribute to a wider group of SLPs on an international scale outweighed the limitations of a localized study that may not have yielded sufficient information. Increasing the sample size also reduces the sampling error. Whilst the Internet is a useful mode of conducting surveys targeted at very specific populations (Dillman et al., 2014), an inherent limitation of online sampling is that there is no available sample frame of Internet users. Therefore, it relies on some form of non-

probability sampling and it is not possible to calculate sampling error and non-response error. One cannot assume that registered members of a professional organization are representative of all the members of that profession. This is very pertinent in the South African context where most SLPs are not members of SASLHA. Increasing the representativeness of the invited samples reduces response bias (Balter & Brunet, 2012). Although increased sample size does not necessarily representativeness, the sample population was purposive, and not all SLPs fitted the research criteria. Increased sample size results in increased confidence of the estimate and greater precision of the sample (Charter, 1999). Coverage error occurs when surveys are only drawn from a particular area that does not encompass all the elements of a specific population (Dillman et al., 2014). In order to minimize coverage error a network sampling technique was used in order to disseminate the survey to SLPs that use apps for therapy. Balter and Brunet (2012) found that using virtual networks incorporates random elements (the random selection of the virtual groups, the contact to every member inside them, etc.), and this should be considered in the analysis of representation bias. Additionally, the possibility of accessing offline contacts by the recommendation given by online ones can reduce problems associated with selection bias and representation.

Measurement error occurs when the answer that a respondent gives is inconsistent with their characteristics, inaccurate, or too vague. This is usually due to poor wording of the questions (Dillman et al., 2014). Questions were checked and piloted using cognitive questionnaires discussed above in order to ensure that they were clear.

Nonresponse error occurs when less than the total amount of surveys that were originally distributed are completed and returned (Dillman et al., 2014). However the use of a Web-Link together with a network sampling technique excludes the ability to identify the number of SLPs who receive the email to partake in the survey and therefore this number is

unknown. Online survey literature states that response rates can have very little impact on non-response bias and there is no universally acceptable nonresponse rate (Johnson & Wisler, 2012). In order to obtain more in depth information, a follow up interview with some of the participants was conducted.

3.9 Recruitment of Participants

Several strategies were used to recruit SLPs who have knowledge in the use of apps for language intervention.

1. Professional organisations in the respective countries were contacted and asked to provide names and mailing lists of potential participants. Monroe and Adams (2012) found that by personalizing the message and using repeated contact, response rates were increased significantly.
2. Organisations, which declined to release mailing lists, were asked to email or publicise the study to their members on behalf of the researcher. A synopsis of the purpose of the study was provided to them.
3. Social network groups (Facebook and Twitter) were used to recruit SLPs who use apps.
4. SLPs were asked to identify potential participants.
5. Participants who received the survey from multiple sources were asked to complete the survey only once.
6. Survey participants were asked to consent to a follow up interview after completing the survey.

Whilst it was envisaged that databases could be obtained from the relevant speech pathology organisations, apart from SASLHA, none of the organisations agreed to distribute

the survey to their databases via e-mail. Both ASHA and CASLPA requested remuneration in order to distribute to their database and the researcher made the decision not to do this. An advert was placed on the CASLPA website as a news post. SPA and RCSLT placed adverts in their bi-monthly research newsletters. For this reason, the survey was kept open for a longer period than originally anticipated in order to accommodate the adverts in these newsletters. The survey was kept open for 6 weeks from the 29 January 2016 until 11 March 2016. SPA placed a notification on their Facebook page, as did NZSTA.

An Internet search of speech pathologist databases registered with ASHA, SPA and RCSLT allowed the researcher to obtain contact information for many therapists. A general email was sent to therapists requesting participation. All emails were sent as a Blind carbon copy (Bcc) so that recipients email addresses were not visible. In addition, the email requested that therapists forward the survey on to any colleagues who may fit the criteria. Time constraints prevented follow up emails being sent to participants.

The researcher also used Facebook and Twitter to advertise the survey. The Twitter hashtag #wespeechies and #SLPeeps were used to identify the survey to SLPs. A number of participants shared the details of the survey on their professional Facebook pages.

3.10 Online Interview

3.10.1 Second phase. Creswell (2013) states that personal interviews are an important way to explore information about behaviour and probe people's thoughts. All participants who completed the survey were invited to participate in an online interview. The interview was aligned with the objectives of an explanatory study in which quantitative findings identify broad issues that require further investigation (Creswell, 2013). The interview provided an additional measure of checking the accuracy of respondents' information

(Silverman, 2013). Guest, Bunce, and Johnson, (2006) state that sampling should continue until the information yielded has reached saturation, that is, a category could not be further expanded upon. However the authors emphasise that "although theoretical saturation is the most commonly used term in published works, frequency of use within multiple bodies of literature has resulted in its meaning becoming diffuse and vague" (p. 67). Since the purpose of the interview was to refine and explain the quantitative data by exploring participants' views in more depth, saturation of data occurred when the information obtained allowed for the development of meaningful themes and useful interpretations (Guest et al, 2006). The authors conclude that for studies with a high level of homogeneity among the population "a sample of six interviews may [be] sufficient" (p.78). However, since the data originated from a number of different countries, it was felt that it was necessary to obtain interviews from participants in the different countries. The interviewed participants were randomly selected from respondents who had consented to the interview after the survey. A total of 16 interviews were conducted and data were analysed using a thematic content analysis. Further detail on the interview participants is discussed in section 3.10.2.

The interview took the form of a semi-structured online interview in which the interviewer uses a schedule of structured questions, but has the flexibility to probe more deeply and deviate from the interview schedule where needed (McMillan & Schumacher, 2001). This format also allowed flexibility in terms of the order that the interview questions were presented, exploration of topics that interview participants raised, probing and clarification of ideas (Gillham, 2008). The interviews were between 20 to 30 minutes each.

Skype and FaceTime were used to conduct the online interviews for the majority of the participants. Skype-Out (data to landline call) was used for one participant who did not have access to a WiFi connection at work. Janghorban, Roudsari, and Taghipour (2014) have

identified this tool as a synchronous online service that offers researchers the possibility of conducting individual interviews comparable to onsite interviews. Additionally, the use of the online interview allowed the interview to occur in more convenient conditions for the participants. This flexibility enabled the researcher to reach an international population of SLPs and increase participation.

A limitation of an online interview is that the selection of a disruptive environment could affect interviewee concentration and data gathering. It may be difficult to establish good rapport with the interviewee because of lack of personal presence involved (Hewson & Laurent, 2012). A further difficulty may occur because of time differences in different parts of the world. Therefore the researcher had to make some concessions in order to make the interview at a time that was convenient for the respondents.

As with the questionnaire, participation in the interview was voluntary and therefore representativeness could not be inferred (Dillman et al., 2014; Oldendick, 2012). The aim of the qualitative interview is not to generalize, but to explore specific phenomena on which to build further knowledge (Thomas & Mgilvy, 2011). The interview protocol was developed based on the results from the quantitative analysis of the survey. Interview questions are provided in Appendix B.

3.10.2 Interview participants. A semi-structured online interview (Appendix B) was conducted with 16 participants in order to explain the quantitative data by exploring participants' views in more depth. Although Guest et al. (2006) state that that for studies with a high level of homogeneity among the population, a sample of six interviews may be sufficient, it was felt that it was necessary to obtain interviews from participants in the different countries. The participants within each country who had indicated consent to a further interview were assigned a random number (using Excel's random number

function). The participants were then sorted by increasing random number (thereby randomising their sequence). The number of interview participants selected from each country was based on a proportional representation from the survey respondents. Therefore seven interview respondents were from the United States of America (USA), four were from the United Kingdom (UK), three from Australia and two from South Africa. Data were analysed using a thematic content analysis, which is discussed below. Table 2 provides a summary of interview participants, grouped according to their country, age, work-setting and age of the population that they work with.

Table 2.

Interview Participants

Participant	Country	Age	Work Setting	Ages Treated
1	USA	60 years +	Public School	3- 14 years
2	USA	40 – 49 years	Elementary School, University	3 – 12 years
3	USA	30 – 39 years	Private Practice	15 months – high school
4	USA	40 - 49 years	Public School - Rural	3 – 14 years
5	USA	21 - 29 years	Elementary- Middle School Paediatric Outpatient Centre	4 – 14 years 5 years & under
6	USA	21 – 29 years	Special Needs Preschool	3 – 5 years
7	USA	30 – 39 years	Private Clinic E I programme – home visits	2 – 3 ½ years Up to 3 years
8	UK	40 – 49 years	Private Practice	2 ½ - 12 years
9	UK	40 – 49 years	Private Practice	3 – 12 years
10	UK	40 – 49 years	Private Practice	2 – 18 years
11	UK	40 – 49 years	Private Practice - schools	4 – 18 years
12	Australia	40 – 49 years	Private Practice	1 ½ - 14 years
13	Australia	50 – 59 years	Private Practice	2 – 12 years
14	Australia	50 – 59 years	Private Practice	1 ½ - 12 years
15	South Africa	50 – 59 years	Private Practice - school	5 – 14 years
16	South Africa	50 – 59 years	Private Practice	2 – 24 years

EI – Early Intervention

3.11 Credibility and Reliability of the Interview

Silverman (2013) describes validity as the extent to which the interpretation of the data represents the phenomenon under study. The following procedures were employed in order to maintain validity.

Each interview was recorded using an Olympus digital voice recorder (DS-30) and transcribed verbatim by the researcher as soon as possible after each interview. Transcription of the interviews also allowed the researcher to obtain initial perceptions about the data. Achievement of credibility occurs by checking for the representativeness of the data as a whole. To establish credibility, the researcher reviewed the individual transcripts, looking for similarities within and across study participants. An independent rater who is a speech pathologist with a Masters qualification checked the reliability of the transcriptions. The rater listened to audio excerpts from randomly selected interviews. The transcriptions were found to be accurate. Respondent validation occurred during the course of the interviews in order to clarify any information that was not clear. In order to enhance confidence and credibility of the findings, triangulation of data from the quantitative and qualitative data was done. In this study, the survey was designed in order to obtain initial information regarding the features of iPad apps. Thereafter, the qualitative interview questions were designed to explore the information in more depth. These methods complemented one another and provided credibility to the study (Creswell & Miller, 2000).

The term reflexivity (Lincoln & Guba, 1985) requires a self-critical attitude on the part of the researcher about how one's own preconceptions affect the research. One of the difficulties I encountered was related to some naivety from therapists about the wide range of apps created specifically for language therapy as well as resources available for obtaining information about apps. Consequently many therapists asked questions pertaining to this. In order to limit imposing my own biases this information was discussed after the interview or via email correspondence.

3.12 Data Analysis

3.12.1 Survey. Quantitative data were analysed by means of descriptive analysis to

determine general trends in the data (Creswell & Plano-Clark, 2011). All variables were categorical and were summarised by frequency and percentage tabulation, and illustrated by means of bar charts. Data analysis was carried out suing SAS version 9.4 for Windows.

3.12.2 Interview. A theoretical thematic analysis of the interview data was conducted. This form of thematic analysis is driven by the researcher's theoretical or analytic interest in the area. This method provides more detailed analysis of the data that emerges from the survey (Braun & Clark, 2006).

Qualitative data analysis comprised a number of stages:

- Each interview was audiotaped and transcribed verbatim.
- Preliminary exploration of data and content analysis
- Development of a qualitative codebook with predetermined codes. However the codebook can evolve and change during the study based on close analysis of the data (Creswell, 2013).
- Coding of data by assigning a label to each unit
- Verification of the codes through inter-coder agreement
- Codes grouped into themes

The identified themes linked closely to the data itself and were not based on pre-existing codes/themes. However since the semi-structured interview questions were designed to elaborate on the existing quantitative data, information that emerged related closely to the research questions under consideration. Thematic analysis was both inductive and deductive since latent themes were also considered (Braun & Clark, 2006). Latent themes refer to information that was not explicitly stated. After the data were transcribed, responses were grouped together if they shared common features. Each theme was checked and compared with the data to establish analytical categories. The data were then rearranged according to

the thematic framework to which they related and a thematic map was created which represented the facets that contributed to each broad theme. The data were given to an independent rater who is an SLP with a Masters level qualification in order to determine level of agreement between the researcher and the independent rater. The rater was familiarised with the quantitative data and identified codes. Following this, the researcher and the rater jointly coded one transcript. The rater then independently coded eight transcripts (50%). There was 100% agreement with two of the transcripts. She did not identify any new themes in any of the other transcripts, however she identified additional comments relating to existing themes in six transcripts. It was therefore agreed that the codes and themes identified were representative of the data.

3.13 Data Interpretation

Data were triangulated from the quantitative and qualitative date sources and integrated. The triangulation of the findings allowed the researcher to gain an understanding of the data in its entirety and hence construct accurate and feasible implications from the data. As a mixed method study, the quantitative and qualitative data are presented and analysed sequentially, with an integrated discussion at the end (Onwuegbuzie & Teddlie, 2003). In conducting the analysis neither the quantitative nor qualitative data dominated (Ivankova, Creswell, & Stick, 2006).

3.14 Ethical Considerations

SLPs from a variety of clinical settings were accessed. Approval to proceed with the study was approved by the Faculty of Humanities. Ethical approval to proceed with the study was obtained from the University of the Witwatersrand Human and Ethics Committee (Medical) and the approval was issued (Appendix C). The procedures were carried out to

ensure that the study complied with the ethical standards required in human research. The following parameters were included to ensure ethical compliance of the study: informed consent, confidentiality, non-maleficence and justice, amongst others.

- A letter (Appendix D) was sent to the different speech pathology organisations requesting permission to conduct the research.
- Participants in the study are professionals in the field and no clinical populations were used in the study.
- Information for participants regarding the nature of the study was contained in the survey-monkey link. The request to participate in the follow up interview was also included in the survey link after participants had completed the survey.
- Participants were notified that they were not obligated to participate and could withdraw at any time.
- Although demographic data was obtained in the questionnaires, no identifying data was recorded in order to maintain the confidentiality of the participants.
- A numerical number referred to the names of participants who contributed to the follow up interview in order to protect their confidentiality.
- Contact information of the researcher and supervisor was provided and results of the study will be conveyed if participants request this.
- The researcher and the professional bodies were responsible for sending requests for participation, therefore no spam requests could be sent using the survey tool (Survey Monkey).
- The survey tool does not sell data to third parties
- Data are Health Insurance Portability and Accountability Act (HIPAA) compliant and protected. This is a prerequisite for studies that have American participants.

3.15 Summary of the Methodology

This chapter described and justified the research design and data collection methods in order to obtain the results. An explanatory, sequential, mixed method design was used for data collection. Quantitative data were obtained using a self-developed survey based on the literature. The survey was distributed online to an international group of English speaking SLPs. Network sampling was used in order to distribute the survey to as many participants as possible. Qualitative data were obtained by conducting semi-structured interviews with randomly selected participants who had consented to the interview. The interview was conducted in order to obtain more in-depth information from the quantitative data. Ethical considerations have been outlined together with measures and considerations taken for validity and rigour.

Chapter 4: Results

The analysis of data provided insight into how SLPs are selecting and using apps for language intervention. The results are presented in line with the aims and methodology of the study. The data are organized into two sections. The first section presents the quantitative data that were obtained from the online survey (N =338). The survey analysis provides a broad understanding regarding the use and features of iPad apps for language intervention. In order to obtain further insight into the respondents answer choices, semi-structured interviews (n=16) were conducted. The second section presents qualitative data that were obtained. The findings from the qualitative data are presented in terms of broad themes and the individual elements that were used to construct each theme. Quotations from the participants are provided in support of each theme.

4.1 Quantitative Data

This section discusses the quantitative data that were obtained from the online survey. All variables were categorical and were summarised by frequency and percentage tabulation, and illustrated by means of bar charts. Data analysis was carried out using Statistical Analysis System (SAS) version 9.4 for Windows.

4.2 Demographic information

A total of 435 responses to the survey were received. Twenty respondents who did not provide therapy in English were excluded from further analysis. Twenty-nine respondents indicated that they had developed or contributed to the development of an app and were also excluded. Twenty-six respondents indicated that they did not use apps in therapy and 22 respondents failed to complete the bulk of the survey. Descriptive data analysis was carried out on the remaining 338 respondents who completed the bulk of the survey.

Only the first three questions, which related to language, iPad use and development of apps were mandatory, therefore the number of respondents to each question varied. The impact on missing data was not significant.

The majority of SLPs *(n*=162; 51.3%) were from the United States of America (USA). SLPs from Australia *(n* = 50, 15.8%), United Kingdom (UK) (*n*= 42; 14.2%), South Africa (*n* = 30; 9.5%), Canada (*n* = 20, 6.3%) and New Zealand (*n*=5; 1.6%) made up the remainder of respondents with a small percentage of respondents emanating from outside of these countries namely, Austria, Japan and Singapore. The majority of respondents were between 30 and 39 years of age (32.7%). Respondents between 21 and 29 years comprised 16.2% of the sample. Respondents between 40 and 49 years old comprised 24.8% and respondents who were above 50 years comprised 26.4%. Despite the fact that the iPad has only been in existence since April 2010, the majority of respondents (63.6%) had ten or more years of experience. This suggests that respondents with clinical experience are incorporating the use of apps into their intervention and younger respondents, who may have been exposed to technology early in their career, do not appear to be favouring the use of apps more than more experienced respondents.

Most respondents (45.3%) indicated that they worked in a suburban setting and 39.6% indicated that they worked in an urban setting. Fifteen percent of respondents indicated that they worked in a rural setting. However since no detailed information regarding the nature of the geographical location was obtained, correlations between geographical location and use of apps could not be investigated. The majority of respondents worked in either elementary/primary school settings (52.8%) or private practice (51.3%). However a number of respondents indicated that they worked in more than one setting. Figure 5 shows the country locations of the respondents.

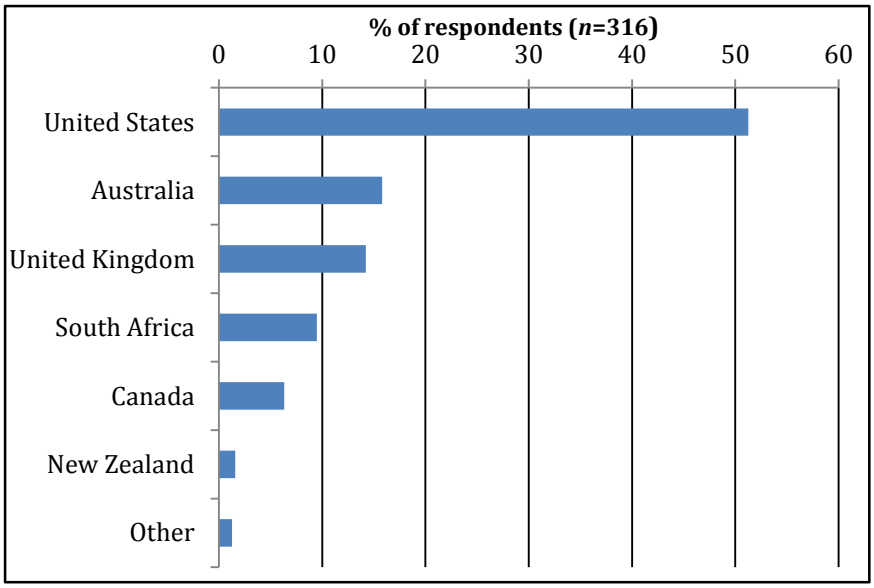


Figure 5. Country locations of respondents

4.3 Reasons for Adoption of Apps

The most important reasons provided by respondents in this study for adopting the use of apps in therapy was student engagement (92.4%) and motivation (88.6%). Portability of the device (76.8%), the variety of materials (70.2%) and activities (65.1%), ease of use (64.4%) and time saved on preparation (56.8%) were also identified as reasons for adoption of use of apps in therapy. The reasons for adoption are represented in Figure 6. The percentages do not sum to 100% since most respondents selected more than one response.

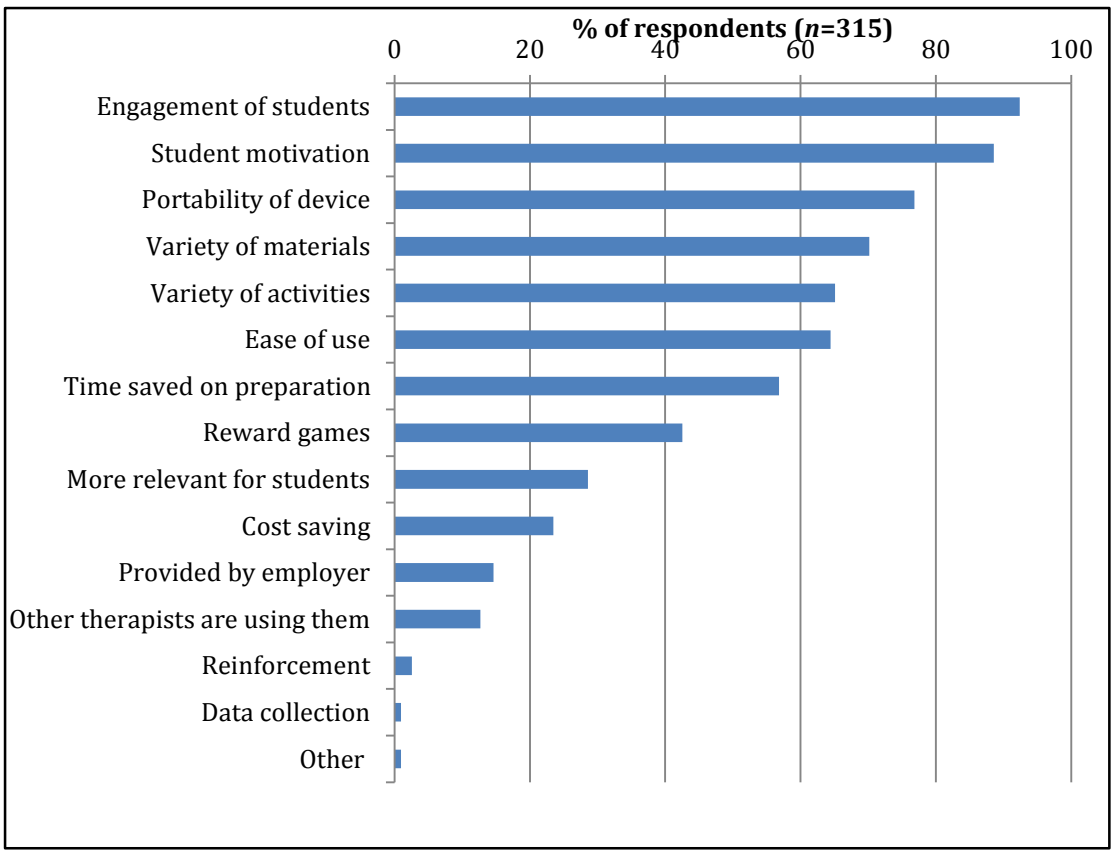


Figure 6. Reasons provided for the adoption of apps in therapy

4.4 App Selection and Use

In order to determine how respondents were obtaining information about apps, respondents were asked to identify the sources where they obtained information about apps. The majority of respondents reported that they obtained information about apps for therapy via word of mouth (81.6%), followed by social networks and blogs (68.4% and 63.9% respectively). Interestingly only 22.8% of respondents looked at the developer sites in order to obtain information about apps, yet information regarding the background and evidence contained in the app is often provided on the developer site. Results reflecting how respondents are obtaining information about apps are shown in Figure 7.

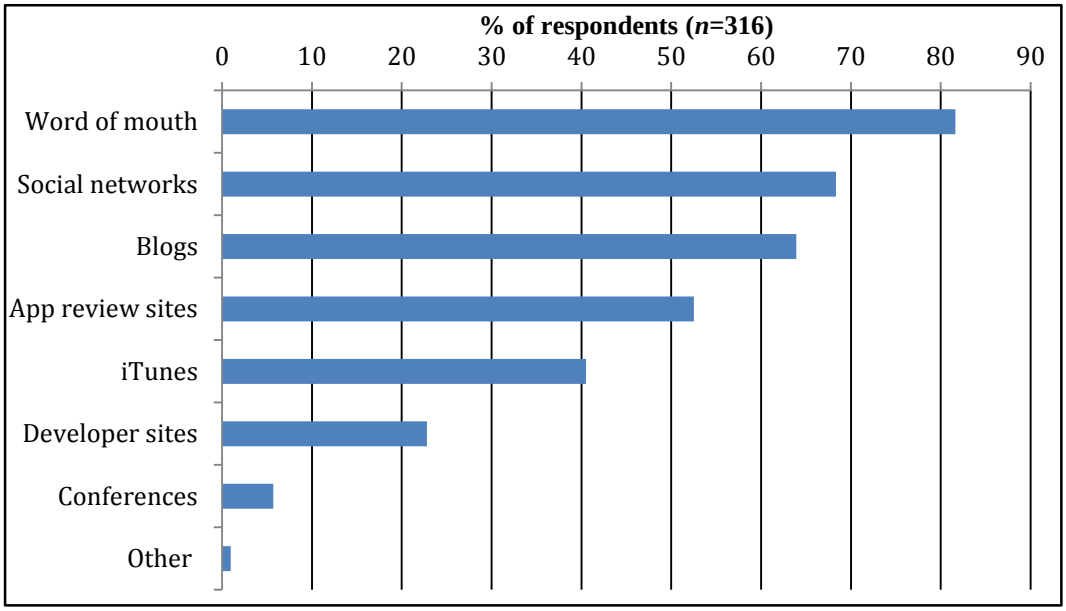


Figure 7. Methods of obtaining information about apps

Some apps provide a free or low cost version of an app referred to as a lite version. The lite version is a feature restricted version of the full-featured app so that users can obtain information about the app. The option to trial a lite version was felt to be important before purchasing an app and 57.5% indicated that they trialled a lite version and 40.3% indicated that they sometimes trialled a lite version of the app. A small percentage (2.2%) indicated that they did not trial lite versions before purchase.

A five point Likert scale was used in order to investigate how important it was to respondents that apps for language were based on EBP. Respondents reported that when selecting an app for language intervention, it was moderately to very important (67.5%) that the app was based on EBP. Thus despite the fact that respondents reported that EBP was important, the manner in which they are obtaining information about apps does not reflect this. Figure 8 depicts the relative importance that respondents placed on EBP in an app.

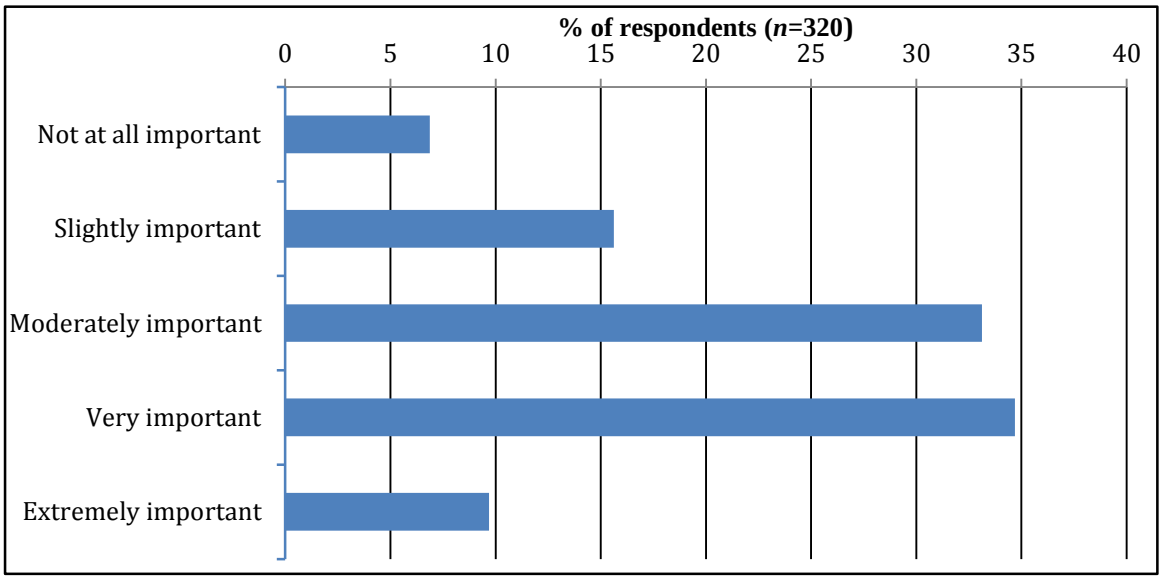


Figure 8. Importance of EBP in an app

The frequency of app use was investigated in order to obtain information on the manner that the participants were using apps. A proportion of the respondents (*n*= 338) used apps on a daily basis *(n*=105; 31.1%) whilst slightly more reported using apps two to three times a week (*n*=108; 32%). The frequency of app use is displayed in Figure 9.

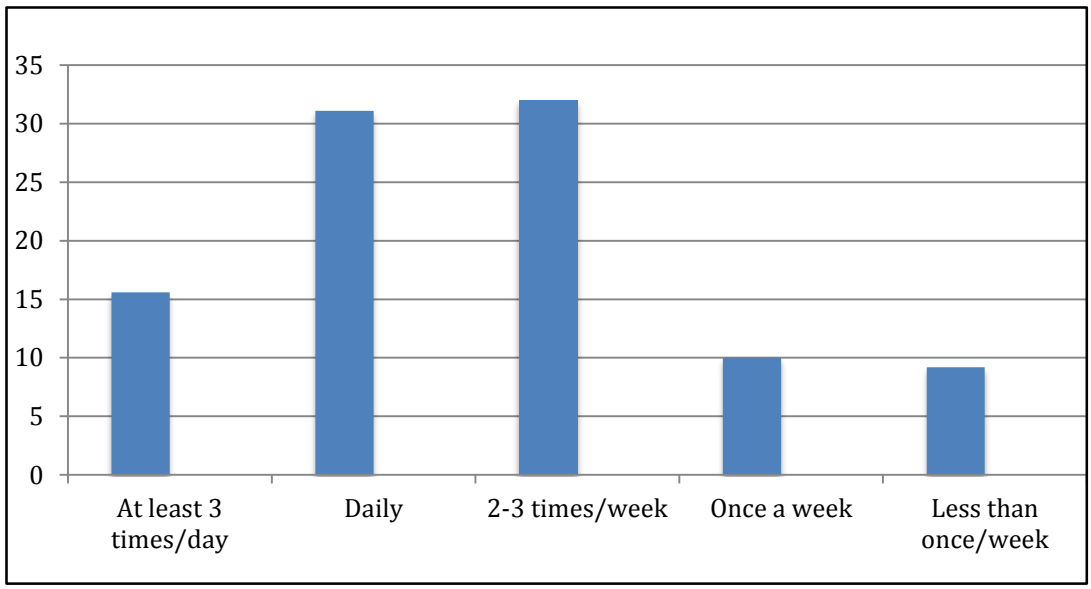


Figure 9. Frequency of app use

The majority of respondents reported using specific language therapy apps (82.2 %) followed by articulation apps (79.9 %) and games (62.4%). The percentages do not sum to 100% since some respondents indicated that they used more than one type of app. The information is shown in Figure 10. Whilst apps designed specifically for language were reported as being most prevalent, this finding may have been skewed because the title of the survey instrument was to investigate features of *language* apps. Thus, respondents who did not use apps for language intervention and favoured articulation apps may not have responded to the survey.

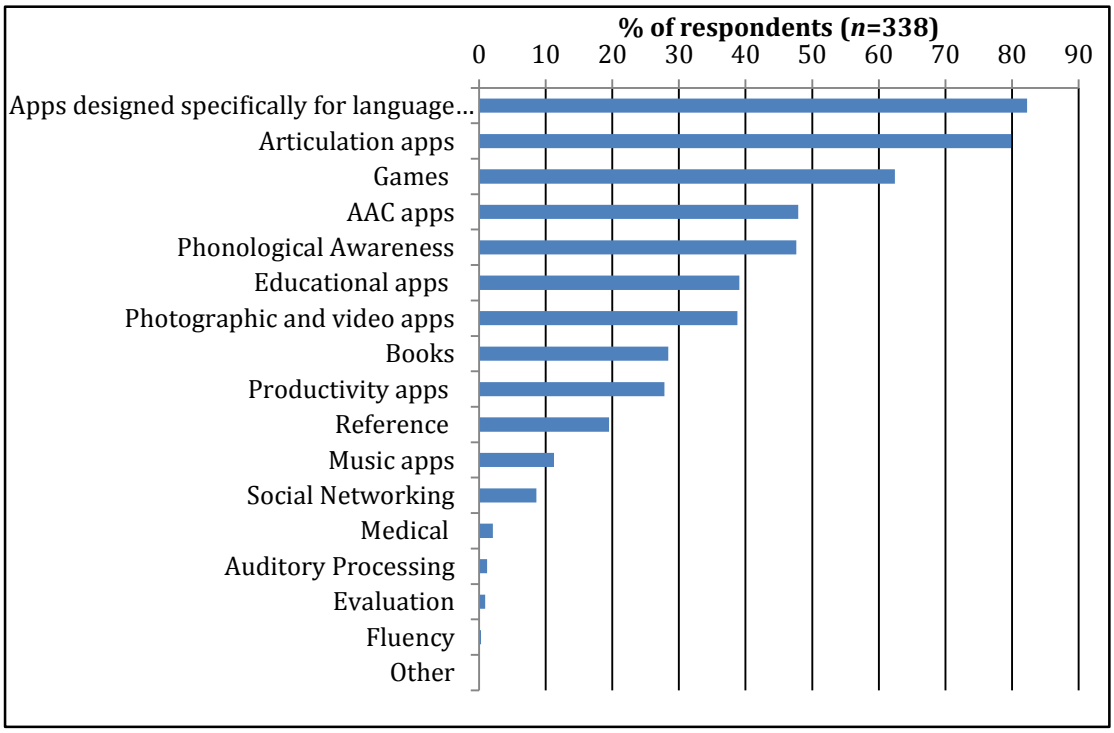


Figure 10. Type of apps used by the respondents

Additional information on respondents use of apps was obtained by asking whether they re-purposed apps. Sixty-five percent of respondents (*n*= 336) reported that they repurposed apps designed in one area in order to target another area.

This question was followed up with an open-ended question to investigate how the respondents were repurposing apps. There were 196 responses, which were examined qualitatively. Respondents referred to specific language, articulation and reading apps that they repurposed for other areas. For example, a language app addressing sentence construction was used for articulation, phonological awareness (*where can you hear the sound in the word?*) and receptive language and semantics. Articulation apps were used for expressive language in sentence formulation tasks. Respondents also reported using game-

based apps and the use of pictures and videos in order to address language skills such as sentence construction, vocabulary development, basic concepts, turn-taking, sequencing, descriptive language and narrative skills.

What was noteworthy, was that the majority of the open-ended responses were very brief and referred to what the respondent believed they had delivered using the app rather than the specific ingredients of the app to address a target.

> "*We talk about pictures or scenarios. We complete description activities and/or sequencing/retell."*
>
> *"I use game apps to target vocabulary."*
>
> *"I use age appropriate apps such as cooking to teach identification, sequencing and social language."*

Many respondents reported that using an app for language intervention helped them reflect on their therapy in terms of the skills they were targeting and how they were targeting it. Sixty-five percent of respondents (*n*=322; 4.7% missing data) indicated that the use of apps helped them reflect on their therapy, 14.3% indicated that it did not and 20.2% were undecided.

4.5 Features of Apps

Features of apps were addressed with regards to the specific content of the app and the design features that could be incorporated into the app in order to facilitate use. These areas were examined separately and then combined to display all features.

4.5.1 Engagement. Animation (40.6%) was reported as being the most effective feature in engaging the user. This question allowed respondents to comment. Responses were categorised under 'other.' Many respondents noted that engagement was often dependent on

the age of the client that they were treating and the type of skill that they were targeting. For example respondents reported that for some children complex animations tended to be distracting. The respondents also noted that it was important that the app did not interfere with social interaction between the therapist and the child. Respondents reported that the ability to have rewards incorporated in the app contributed to engagement. The results are represented in Figure 11.

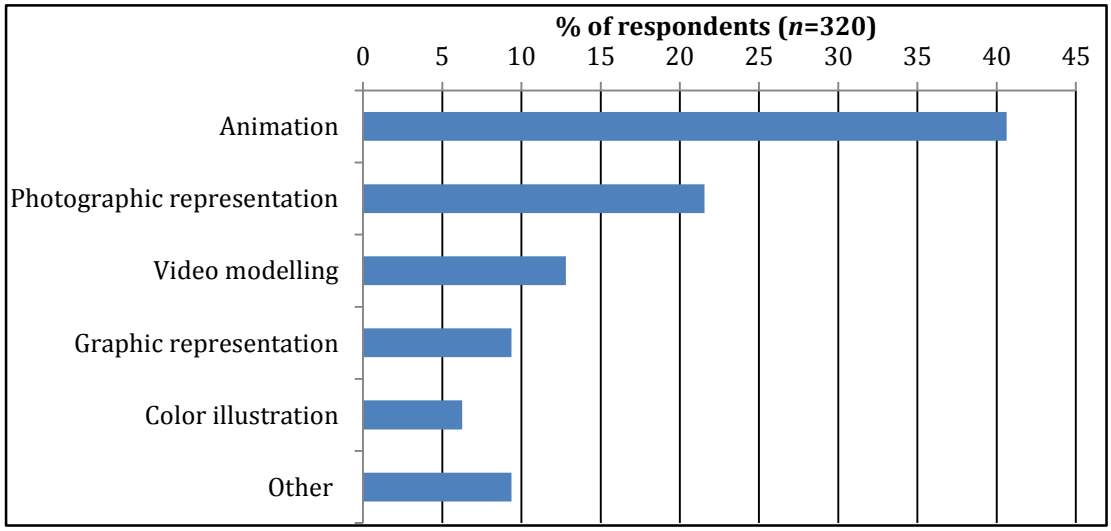


Figure 11. Features of an app engaging the user

4.5.2 Reward. More than half of the respondents (53.1%; *n*=324; 4.1% missing data) reported that a reward incentive in the app was important. Thirty-five percent did not and 11.4% were undecided. The engagement and motivational factors of using an app, identified previously could possibly reflect why a reward incentive in an app was not seen as more important. Furthermore, the fact that respondents appear to be using the app itself as a motivation and reward, suggests that an additional motivator is not as important to many of

the respondents. Respondents reported that if a reward is offered in an app, then a choice of different reward games (37.3%) was preferable.

4.5.3 App design features. Respondents reported that varying difficulty levels (90.8%) and child-friendly themes (84.5%) were important in a language app. This highlights the fact that the respondents feel it is important to be able to scaffold the level of difficulty for the child during intervention by increasing or decreasing the level depending on the child's performance. In addition, the need for varying levels of difficulty may reflect the need to be able to use the same app for different children. The ability to save progress was deemed as important by 66.1% of respondents. The ability to have different user profiles within the app was viewed as important by 62.7% of respondents. Controlling the speed of progression (58.3%), activity selection (57.3%) and text on/off features (57.0%) were other factors identified as important for inclusion in the design of the app. A record feature was deemed to be important by 48.3% of the participants. The information is displayed in Figure 12. The percentages do not sum to 100% since some of the respondents selected more than one feature.

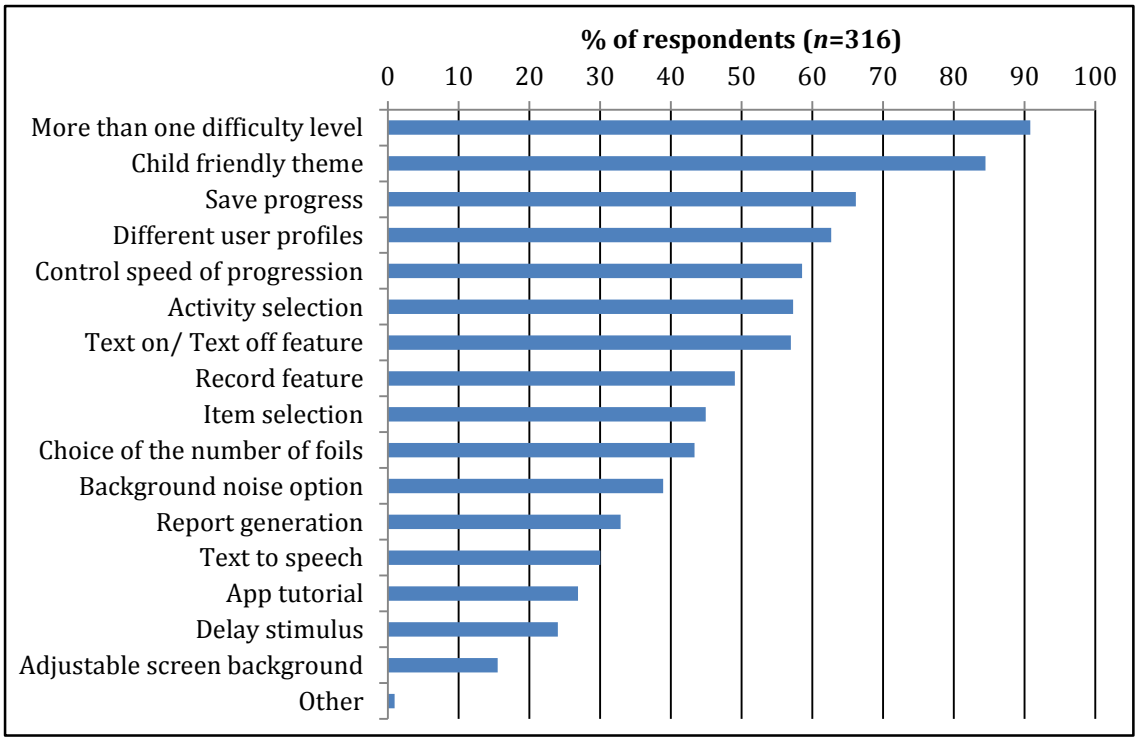


Figure 12. Design features important in an app

4.5.3.1 The narrator's voice. The voice or accent in the app was felt to be very important by 34.7% of respondents (*n*= 320) and moderately important by 33.1% of respondents. Almost 67% of the respondents (*n*=320) reported that they would like to have the option of different voices/accents in an app. Eighteen percent did not and 14.7% were undecided.

4.5.4 Content features. With regard to the content of the app, the majority of respondents reported that it was important to have different developmental or difficulty levels (87.5%) in an app. Visual representation (80.1%) and interactivity (78.5%) were also considered to be very important. Multiple learning modalities (60.7%) and examples for practice (56.1%) were also rated as important. Participants (51.1%) also noted that the availability of both an auditory and a written model was valuable. The percentages do not sum to 100% since some respondents selected more than one feature. This is shown in Figure 13.

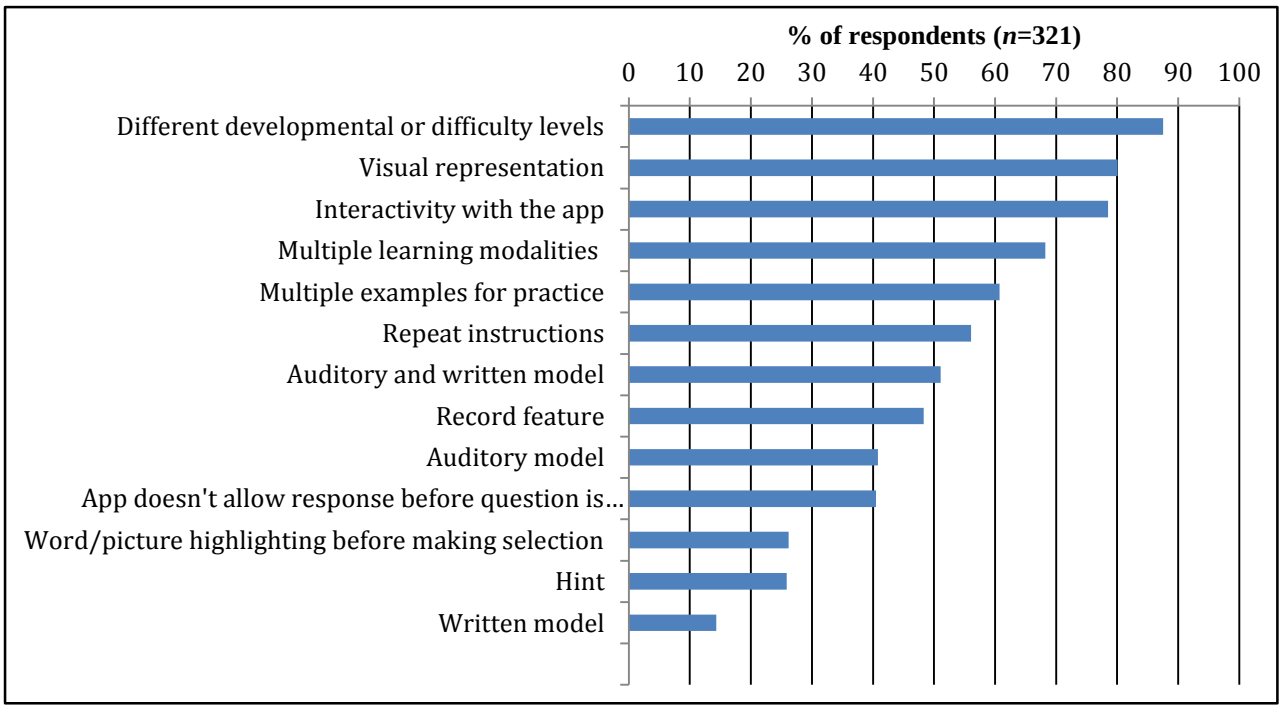


Figure 13. Content features important in an app

4.5.5. Design and content features. As can be seen, when looking at both design features of the app together with the content features of the app, participants reported that having different developmental or difficulty levels was most important. It must be noted that a question about different developmental or difficulty levels was included with regard to content and design features of apps, since different levels can be built into the content and/or the design of the app. Therefore the average value for different developmental/difficulty levels was used. The design and content features are depicted in Figure 14.

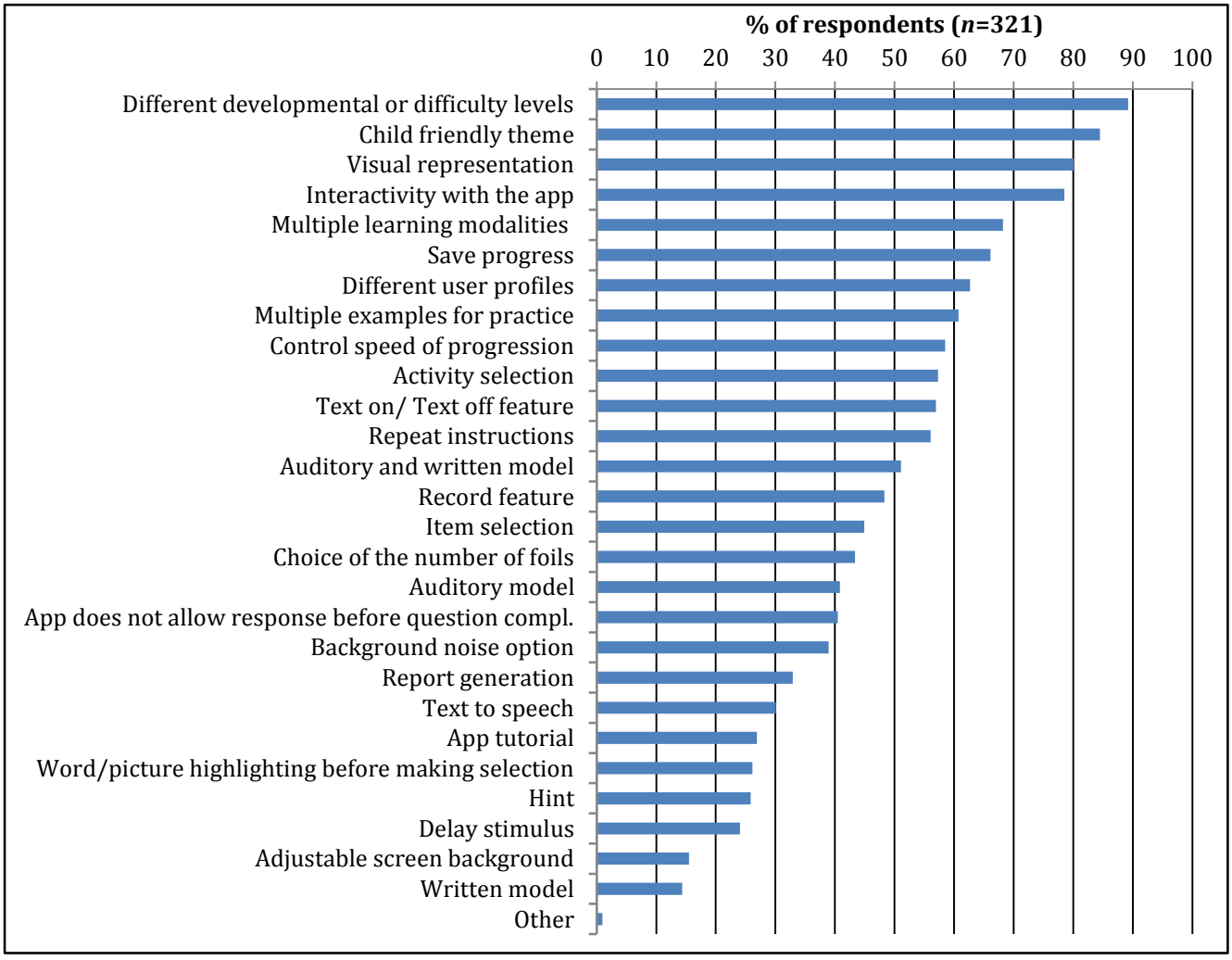


Figure 14. Combined design and content features important in an app

4.5.4.1 Error response. Most participants (*n*=321) reported that when a child made an error, they would like the feedback to be immediate (76.3%), 13.8% did not and 10% were undecided. The option to try an item again (76%) was felt to be most important when the child made an error on an item. Reducing the level of difficulty of the task was reported as important by 38.6% of respondents. Corrective audio feedback from the app was felt to be important by 28% of respondents. Qualitative analysis of responses classified under 'other' reflected that respondents felt that different children required different types of input and that it was the role of the SLP to be able to adjust settings in the app to cater for the needs of different children. The results are displayed in Figure 15. Percentages do not sum to 100% since some respondents selected more than one type of response.

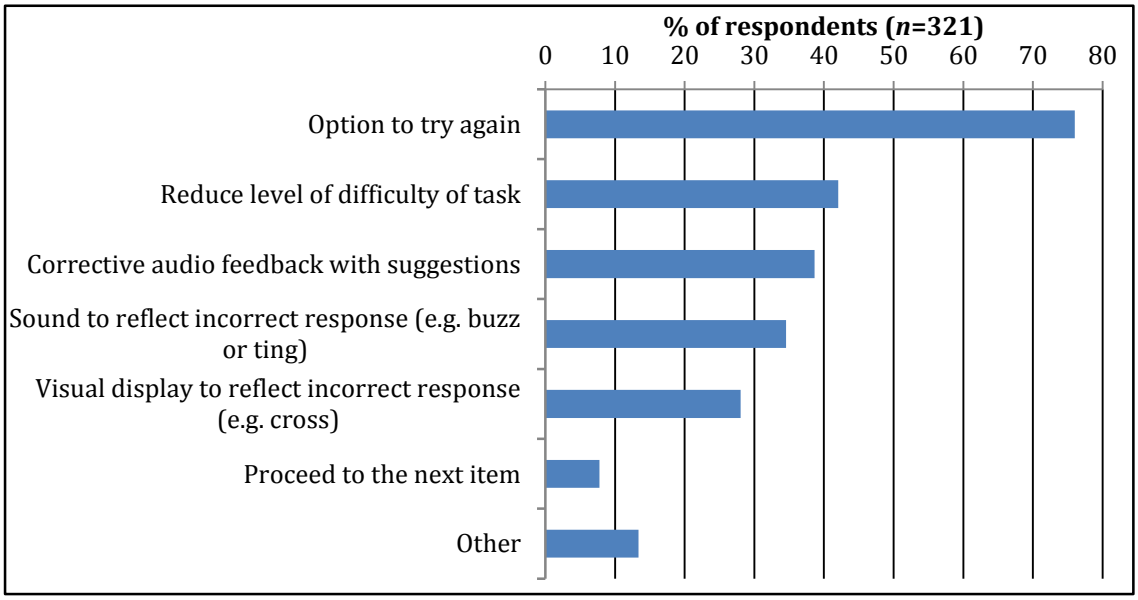


Figure 15. Error response from the app

4.6 Education

About 59% of respondents (*n*=315; 6.8% missing data) felt that they would like to receive further training on using iPads for therapy. Twenty-four percent did not want further

training and 16.5% were undecided. Most respondents (72.2%) felt that they would like to receive further training via webinar. Fifty three percent stated that a professional workshop would be beneficial.

4.7 Qualitative Data

The results of the survey provided a broad understanding of the research questions. Namely: To identify the features that SLPs identify as germane when selecting and using an app for language therapy; to identify some of the reasons why SLPs have adopted the use of apps in their therapy; to identify how are SLPs selecting apps for language intervention; and to investigate how they are incorporating apps into their therapy.

4.7.1 How SLPs are using apps. Qualitative information from the survey was obtained by asking respondents to describe how they used apps in therapy. There were 319 responses recorded to this question. Responses were generally succinct and respondents did not provide detail in terms of how they used apps in therapy. Vague responses such as "*to augment therapy activities,"* "*for therapy tools…. Articulation and language goals*," and "*to elicit language, increase MLU*[5]*, choices, behaviour management, help with speech goals"* reflected the type of response that was recorded. Although many respondents reported that they used apps to reinforce language goals, they did not expand on *how* they did this. Many respondents also reported that they used apps to engage and motivate children, and as a reward. For example, "*say the sentence and you can add a piece of a car."*

What was noted was that even though language apps were reported to be the most prevalent type of app (Figure 10), almost all of the respondents reported that they used

[5] MLU refers to Mean Length of the Utterance

articulation apps.

4.7.2 Semi-structured interview. A semi-structured online interview (Appendix B) was conducted with 16 participants in order to explain the quantitative data by exploring participants' views in more depth. Data were analysed using thematic content analysis, which was discussed in the methodology.

The analyses of the data led to the construction of three broad themes. Each of these themes contained a number of subthemes. These are discussed in detail with quotes from the participants relevant to each theme. A summarised table of the initial themes that were identified is provided in Appendix E. Example responses (written in point form), from eight participants are provided in order to reflect the overall results.

The first theme was *use of apps as a tool*. The second theme was the *manner in which respondents are using apps*, and the third theme was the *features of the apps*. The first theme and the related subthemes are depicted in Figure 16.

What was noticeable by virtue of omission was none of the participants that were interviewed expressed any reservations regarding the researcher's status as a speech-language pathologist. The interviewed participants all answered questions regarding the nature of their intervention by assuming shared knowledge and practices and using terminology that would be understood by another professional in the field. This supports the notion that similar practices are being adopted by SLPs internationally.

"My first app was a very poorly designed praxis assessment….." [P2]

"It impacts around articulation, vocalic /r/ that kind of stuff." [P12].

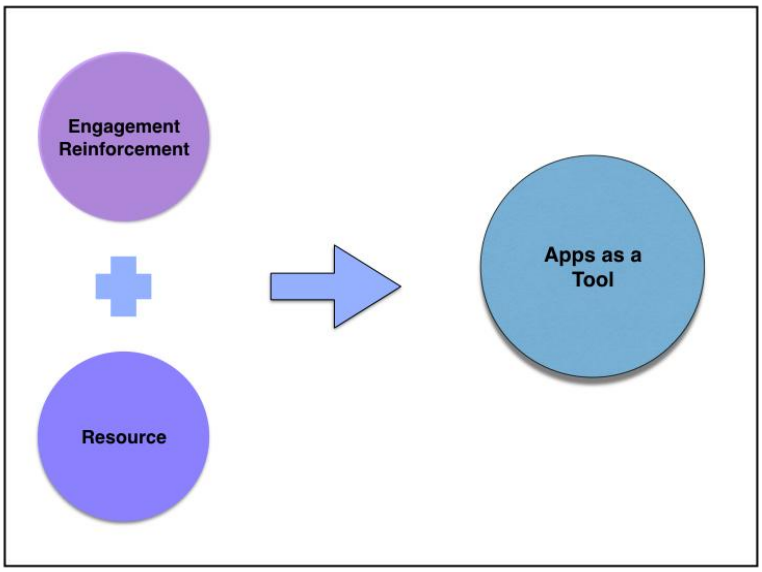


Figure 16. Theme 1: Apps as a tool

4.8 Apps as a Tool

All the participants interviewed reported that they viewed apps as a tool and that they were a means of engaging and motivating children in the therapy process. However, the participants emphasised that they were still in control of the therapy process.

> *"The app is just the material or the motivation part of the session. The app is presenting the target in perhaps a more attractive and exciting kind of way."* [P12]
>
> *"…I guess like I do the same thing, I just use it as a tool."* [P5]
>
> *"I don't think that my role as the therapist changes at all with the iPad. It's just that I have a really exciting tool that I can bring in to help me."* [P16]
>
> *"I view myself as the person providing the material and it's just a different means to*

> *provide the material……Like kids aren't studying vocabulary cards at home any more. They are learning through iPad and TV. So I am trying to engage their learning in a way that's familiar to them."* [P6]

Participants reported that apps expanded their therapy resources. The number of resources and portability of the iPad was particularly relevant for participants with large and varied caseloads.

> *"….From a resources thing, you can have a huge bank of resources I guess in a very small piece of kit. I think it does give that variety to a session."* [P9]

> *"I feel like a lot of times the apps are really good at coming up with lists…..Sometimes I don't have the time to think up those things myself."* [P 7]

> *"……it is just so flexible. It is a small thing that I can carry around and I can pull things out of it very quickly"* [P1]

> *"Definitely having apps at my fingertips gives me a little more flexibility……. Planning time is tight, It's like I keep them in my hip pocket and pull em out when I need them for something quick and fun and easy……. So there almost can't be enough language tools out there. I think because it's a wider area, there's more variability."* [P4]

> *"It's kind of saved me a few times from having to take huge bags. So I think in that way it's just given me more options."* [P11]

The second theme that emerged was the manner that participants incorporated the use of apps into their therapy. A number of subthemes were incorporated into this theme. This is depicted in Figure 17.

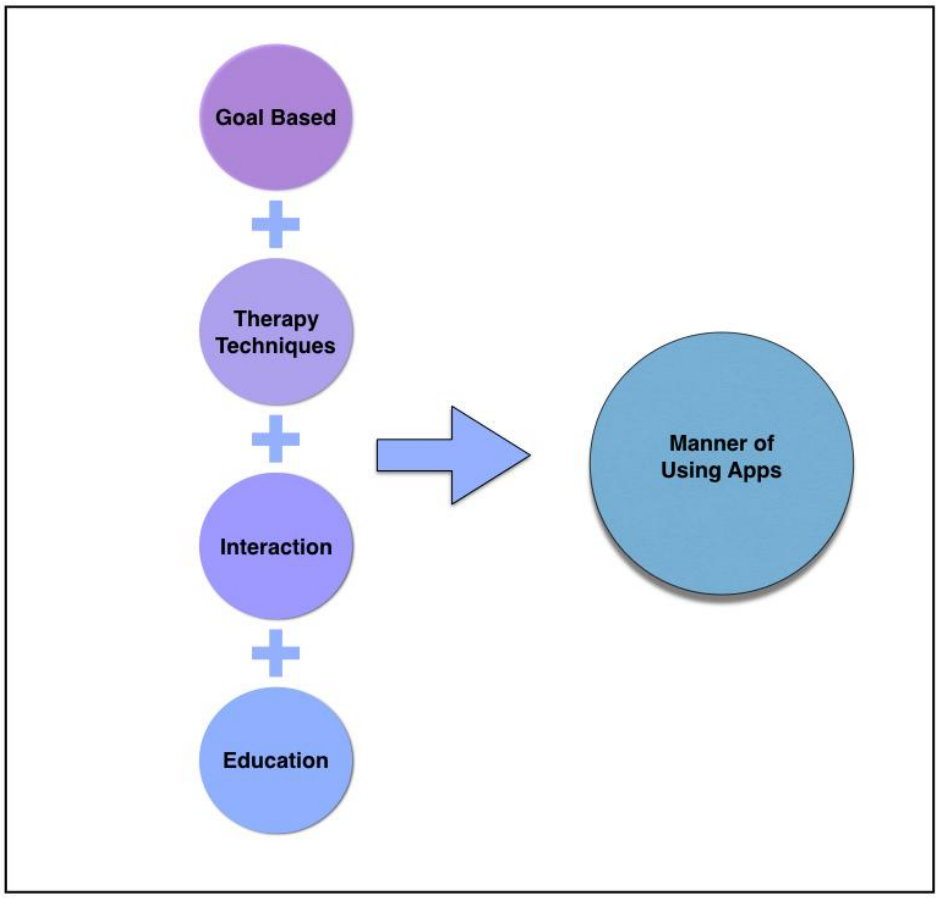


Figure 17. Theme 2: Manner of using apps

4.9 Manner of Using Apps

4.9.1 Goal based. The way the participants use apps in their intervention is closely related to the previous theme of an 'app as a tool' which is used to facilitate and enhance therapy. Participants reported that the role of the therapist is to facilitate and control the use of the app based on the therapy targets. Participants reported that their use of apps was related to the therapy goal and not the features or the content of the app.

> *"….it's because of the way I use apps which really, I use them like I would a toy or a game……It's something you would have to manage."* [P14]

> *"It's very important that I first have my goal and my developmental level and then I use the apps in different ways……. When a child is on the iPad I am very involved in how they are managing."* [P16]

> *"It doesn't take over from me being the clinician…..My practice is still driven by the clients' needs and their presentations."* [P12]

> *"It's more traditional direct therapy with me facilitating and working toward specific objectives."* [P8]

> *"Very much a facilitative role. I often adapt the app to the need that I have."* [P 15]
> *"This is my target, what apps out there would kind of fit that, rather than I'm looking for a language app that purports to do a certain thing."* [P1]

> *"It's not gonna change what I'm doing with the kid or what my goal is……I don't write my goals and write my therapy around the app."* [P3]

Although interview questions referred specifically to apps designed for language therapy, many respondents reported that it was not necessarily important to only use specific therapy apps. Respondents noted that 'game based apps' could be an effective tool. They reported that it was part of their role as a therapist to adapt tools to suit the needs of the child.

> *"A lot of my language work these days I do with apps that perhaps aren't speech pathology apps as such……. I like those because they are more play-based I guess and they are still motivating for clients but I get more kind of realistic kind of language back."* [P12]

The comments made by P12 relate specifically to her approach to intervention, which she described as being more play-based rather than a more structured approach where she felt that the language elicited was not always "natural sounding."

> *"Some of the daily language things I use are not therapy devices…… I do a lot of those sorts of things which are not therapy apps. I get a lot out of them.* [P13]

> "*How to use fun apps for language intervention. You don't just need to look up apps that are specifically for intervention, you can really just find something that gets the kid talking."* [P5]

> "*I use a couple of apps that aren't specifically designed for language work. Sometimes those apps can actually be better than the ones that are specifically designed for language."* [P10]

Thus, even though participants used different approaches to intervention, they still reported the need to base their intervention on the language goal.

4.9.2 Language intervention techniques. Participants reported that the use of apps allowed them to artificially create situations in order to elicit the goals or targets that they were targeting. They also stated that the use of apps could assist in the identification of areas that may need to be targeted. Some participants reported used a more child-led intervention approach, whilst others reported using a more structured intervention approach.

> *"…often with the language work, in order to try and facilitate the language structures you want, you often have to artificially create situations. So things that you might find difficult to facilitate using real resources or real materials, is often easy to do that with an app."* [P10]

> *"Apps also make some things easier to achieve in the clinic room. For example – listening in background noise, producing levelled instructions. ……It is so specific it really hones you into the goal that you are working on….because sometimes I think we are all a little bit guilty of goal drift when we start working on something and something else pops up."* [P12]

> *"I think that in our simulated therapy room or environment you can work on articulation in that environment, but language is just so much more diverse that the activities we have in our room and the cards we have. I think it just opens up more."* [P16]

> *"It's a structure to work with……I think we all sometimes might not get it quite right. I might be working with a child doing something and then go ooh, hang on a sec, I've just realized there's a gap there we need to go back and fill that gap and perhaps if it something more structured you are going to work through the phases."* [P9]

> *"Sometimes the design of the app helps me figure out ways that I need to break this goal down into more discrete pieces."* [P4]

Thus findings showed that many participants felt that using structured apps assisted them in identifying areas that require intervention because of the nature of the app itself. In addition, some apps assisted them in breaking up tasks into manageable goals. Participant 2 describes the apps as being *"like a teacher*" which allow her to develop her skills as a therapist. Specific therapy techniques that can be incorporated into apps are discussed in relation to the features of the apps further on.

Many participants acknowledged the lack of research around the use of apps for therapy. In the absence of a literature base, participants reported using their own clinical knowledge to incorporate apps into therapy. Participants reported that they had to adapt their clinical knowledge of specific intervention strategies to use with apps. However, SLPs acknowledged that their knowledge may not be sufficient and they reported that they would like more specific guidelines and further education about how to incorporate apps more effectively into therapy.

> *"It's my own clinical experience that I'm using. That's what I'm using to decide what to work on, and where to go and norms and all those things."* [P15]

> *"I might be the one that judges whether the production was good or incorrect…..I will give them positive feedback if they are successful with a particular…..or problem……I know this is doing what it says it's doing because I also have experienced teaching that way*." [P2]

> *"I know modelling is evidence based practice that works. I'm looking at what I know to work for me in a therapy setting. So my clinical experience."*[P4]

> *"It's really based on those more like classic strategies for working with these kids……You're using how you know how to be a therapist."* [P5]

> *".....if they get the wrong answer you say try again. Then you start giving kids clues and scaffolding so that they can get to the right answer."* [P14]

> *"I think that the problem is it's so fast moving, that almost the research can't keep up." I think there's something to be said for experienced based practice. And sort of talking to colleagues as well."* [P11]

> *I think when you have something that works well and you know that you are getting the outcomes. I think that can't just be wiped aside just because there's no evidence in a formal study about that……..We've seen that apps do work in the clinical setting where we've got some outcomes. So I think that we kind of go with that whole clinic based evidence."* [P12]

With regard to education, most participants wanted to know more about "*what you can get out of the app"* [P11] and "*how to use them appropriately*" [P8]

4.9.3 Interaction. Participants reported that when using apps for intervention, interaction between the therapist and the child was crucial to intervention.

> *"My role as the therapist is to keep the kids talking while they are using the app and asking the right questions to get them to use the language. My job is to keep them interacting with me and make it a shared activity rather than an activity that they are getting sucked into."* [P5]

> *"I am trying to get them to use it as a turn taking engaging activity. And where they have to use their language. They want to use the item so much that I can get more out of them than if I am trying to use simpler materials."* [P1]

> *"…….I'll buy this app and it will teach my kid pronouns. Well it's not going to if you are not using it correctly and there is no adult human being helping."* [P3]

> *"The app is a collaborative effort between me and the kids……..It's all about engagement and togetherness."* [P7]

> *"It's a three way relationship between apps, me and the child. So there will be lots of stopping and starting of the app so that we can comment together …."* [P8]

> *"It is still to do with the relationship and it's still to do with the interaction. It's finding the way to get everybody involved in actually communicating."* [P13]

> *"A child can't just learn from just watching something by themselves; they need that interaction to help facilitate the learning."* [P6]

4.9.4 Education. Many participants reported that they felt that it was their responsibility to provide education for parents regarding the use of iPad apps for therapy and education. Unexpected information that emerged from the interview related to participants' concerns regarding screen-time for children. No specific questions were asked about screen time, but it is clear that the lack of guidelines and possible negative effects of screen-time is of concern to many of the participants.

> *"Showing people what you can get out of an app rather than just going on it and playing."* [P11]

> *"I really try to educate my parents on how to use apps together with their children just like they would any other play thing that they are going to do or any other interaction with their kids."* [P7]

> *"It's not even so much the app, it's who's manipulating the app for the target. And like coaching parents or teachers on how to make whatever they are doing interactive and a learning experience."* [P6]

> *"I don't ever give it to a child to work on independently unless it's something the parents are in the session and they want to get the app at home. Then I will train them in supporting the child to use it."* [P9]

> "*I told a parent if you want to use this as a tool to work on her speech and language make sure you don't give it to her as like busy work. Like to keep her busy. Sit down with her and make sure she is talking to you and you are talking to her throughout the whole activity."* [P5]

> *"I recommend apps to parents to download….. They are usually apps that I use in my sessions and where they've seen how to use them."* [P14]

Participant 13's comment regarding the educational value of apps *" because it says that it is educational on the app"* highlights the importance of being able to identify features that facilitate or detract from learning in order to assist parents.

"I think my role as the therapist is to try and help the family access apps that are appropriate and also show them how they can use them…….It's not a baby-sitting tool, you can't just park a kid in front of an app and that's therapy done. Or that it's educational because it said it was educational on the app. It's not educational unless they are actually learning from it and it's not going to be educational if they are left on their own in front of it." [P13]

"Sometimes I question if this is a good thing because we have concerns about screen time." [P2]

"Yeah and it's still screen time and some parents find that they are on these things all the time, so it's just getting that balance I think."[P11]

"I feel just so nice and current with the iPad. But I have this resistance that I can't use this my whole session. I've got to be balanced." [P16]

"Cos I'm like you know, please stop staring at screens. Stare at my face! So yeah it's the way the world's going… It's obviously got its' place but it's about getting balance." [P8]

"I might come across as quite hypocritical if I am telling them you need to reduce the amount of iPad time and then I am using it within the session. So I think I would have to be sensitive to that." [P9]

4.9.4.1 SLP knowledge. It was clear that although the interviewed respondents were app users, many participants reflected that they felt that they were not making optimal use of this resource. In addition, participants noted that they would like more practical training in terms of how to use apps effectively.

"There are a whole heap of apps that I'm sure I don't use to the maximum ability that they could be used. [P12]

"It would be interesting to hear if someone had interesting ways to use apps to facilitate language." [P3]

"I could probably get more out of using than I currently do." [P11]

"To me getting the most out of an app would be great because I am conscious of options there that I don't even use." [P14]

> *"It's about how to use them in therapy. Because anyone can go read up or check out apps. It's finding how from other therapists how do you manage this or what works best for you….. How to incorporate the iPad into your therapy session."* [P16]

The third theme that was identified was features of apps that participants reported as being beneficial to their intervention or impeding intervention. This is shown in Figure 18.

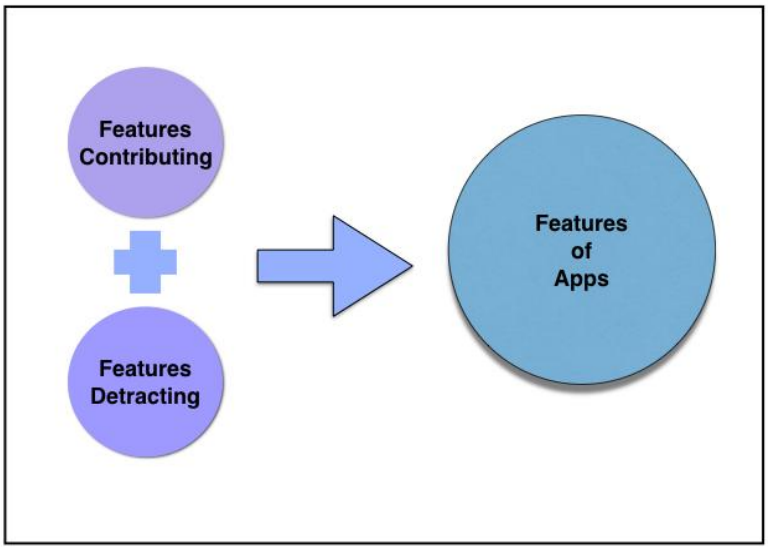


Figure 18. Theme 3: Features of apps

4.10 Features of Apps Facilitating Intervention

4.10.1 A resource providing different levels. Almost all interview participants (*n*= 15) reported that using apps provided them with an additional resource with a range of difficulty levels. Participants reported that the range of resources allowed them to be more flexible and variable in their approach to therapy.

> *"It is just so flexible. It is a small thing that I can carry around and I can pull things out of it very quickly……It's right there ready to go."* [P1]

"There are so many different kinds and types of language goals…….So there almost cant be enough language tools out there……Sometimes the design of the app helps me figure out how I need to break this goal down into more discrete pieces." [P4]

"A lot of apps are designed in a very systematic, step by step (way). You know they go up a level very very systematically……You've got the evidence to back it up quite nicely from within the app." [P10]

"The fact that you can alter that to add the rhymes that you need and the level of difficulty." [P11]

"If you work with language you need a greater variety of tools to work with and for speech pathologists you have that extra tool means that it gives more new stuff coming in." [P14]

"Apps have helped me to expand my intervention…….I've had more resources to do it. You know you could work on it in one way with the equipment you have. Then you felt limited whereas the app has enabled me to do it in many different ways……It gives you resources at different levels and the app provides that for me." [P15]

4.10.2 Customisation. The ability to customise apps based on the child's needs and treatment goals was also reported by respondents as an important feature when using apps. Participants are using apps based on the difficulties that the child is presenting with and the ability to adjust features to suit the needs of their clients is important.

"I appreciate when I have the ability to change the settings based on the child. It makes it less one- size- fits- all."[P3]

"If you could turn off certain features so that you could change the app so that it had less sound effects, or you could turn off the background music, or you could make the colours less contrastive or something like that." [P5]

"I would put customizable features. There's apps that don't let you turn off the music and I can't use some of them. I would want any feature to be customizable." [P4]

".....Being able to turn options on and off and tailor it specifically to the child that I am working with." [P13]

> *"An app that gives you the option to change. Some apps are very flexible. And you can change a lot of settings so apps like that I prefer."* [P14]

4.10.3 Graphics. Many participants reported that the graphics and the type of graphics used in apps facilitated learning. Participants felt that the animation and movement were effective in engaging and supporting children.

> *"The fact that there's actual movement involved…….I choose to work on action words. It's hard to do that with something that is static."* [P1]

> *"It does depend on the child…..So if it is animated there might be cartoons which are frozen pictures, but anything moving definitely draws them in more.* [P4]

> *"The visual stuff and the sound effects…… Lots of language comes up in those. That's one of my favourites. I love the graphics*." [P8]

> "*For me the graphics are very important. Humour is often really good. If there's something funny and amusing. You know a bit silly in some way. The kids particularly seem to respond to the sillier the better."* [P10]

> *"They provide a lot of visuals which sometimes for us as participants, it's much easier to provide those on the iPad…….it makes it so easy to provide support that kids need."* [P15]

4.10.4 Repetition. The ability to have multiple examples for practice and repeat items that were incorrect was also reported to be important by most participants. The need for repetition was closely related to the therapeutic interaction between the therapist and the child. Some participants noted that often the sensitive nature of the touch-screen resulted in error responses by the child. It was therefore important to be able to repeat the target item so that the child could self-correct. Repetition was reported to be an important part of the therapy process so that therapy was more efficient. If a child made an error, participants felt that it was important to use this as a 'teaching moment' and allow the child to repeat the item in order to achieve success on a task.

> *"Getting that repetition they are forced to get a lot more practice. If they keep picking the wrong answer but they don't have the opportunity to correct it. There's kind of a missed learning opportunity when you want to correct it right away."* [P2]

> *"When I am right there with the child when it is wrong, I want to have time to explain it to them and then let them try it again. The other thing is that sometimes they just hit the wrong buttons and get frustrated and it's nice to be able to do that one over."* [P4]

> *"You don't just want a black and white – oh they did it wrong. What probes would make them successful? So if you are providing a different cue or a different way to present the stimulus and then figuring out what made them successful that time."* [P6]

> *"If they get a chance to try again the therapist can then input themselves and then work with the child in whatever they need to figure it out. Use whatever strategies they need to use. It makes it much more useable therapeutically."* [P3]

> *Sometimes they haven't made a mistake because they can't do it, they just need more scaffolding. Or they've made a mistake because they've hit the wrong button because they weren't scanning well or because they lost concentration for a minute. Whereas if you just repeat the task, they will get through it. They don't need extra scaffolding, they just need another go*." [P13]

4.10.5 Pace. Many participants reported that it was important for them to control the pace of the app in order to work effectively with the child. The ability to control the pace of the app facilitated the ability to provide appropriate intervention such as providing additional processing time and encouraging children to self-monitor.

> "*……Pushing the 'next', allows me to teach what I need to on the screen where it's at, before the kid can move on……..I feel like if I don't have control over what they are doing on the app then it actually impedes what I am trying to do because I can't do my goals."* [P3]

> *"Quite often a therapy objective is to work on self-correction. So as long as there is an ability to pause it as well and say you are getting it; that wasn't quite right…….if it's about pausing the app and saying let's have a think about it and you are doing a bit of therapy alongside it."* [P8]

"I always explain to the kids……. I think you need to listen to this to the end. But that's an aspect of the iPad that I find – this quick swipe to the next things a bit of a pain." [P14]

"Sometimes the speed or the way that the app is……. so the flexibility in terms of what it allows you to do once you are in it in terms of moving about in the app." [P10]

"The ability to pause and stop to give kids more processing time. I think some apps are really fast moving and fast paced…….a pause button where you can pause the app until everyone is ready." [P12]

4.10.6. Data collection. The ability to save data was important to participants for a number of reasons. For participants who worked in group settings, with large caseloads, in-app data collection reduced the load on the SLP. Participants, who worked in one to one settings, reported that data collection allowed them to obtain a clearer picture of the child's abilities and assisted them in formulating therapy goals.

"If the app has a data collection feature on it, it really helps you take a quick look at where the child is. There is a very convenient snap shot of your child's progress"
"I don't know how it is there, but here everything is more and more data based. Data, data, data. And so I spend so much time doing that and collecting it. That takes away from my therapy. So anything that does data for me is only to the benefit of the children." [P4]

"Whenever I have an app that takes data for me, that helps me reflect on my lesson a little bit better. Like, oh they really didn't get that and I thought they were getting it…….so then I can go for the next session, let's work on that again this time……I don't have time to reflect during the session" [P6]

"A lot of apps have got record sheets built into the application which really really helps. You actually record exactly what's going on. ……which enables you to kind of reflect on what level they are at. What level are they going to go to next? You've got the evidence to back it up quite nicely from within the app." [P10]

"I like that you can score things. You know you have a thing at the end and you can go and see what they did." [P11]

> *"On an app it's giving you more direct kind of feedback as to how the child actually went rather than more of an impression. And I think too, perhaps because it is so specific it really hones you into the goal that you are working on."* [P12]

4.10.7 Voice and accent. Participants were asked what features of the voice and/or accent they felt were important when using an app since this was a feature that was rated as moderately or very important by most participants in the survey. Most participants that were interviewed reported that the gender of the narrator's voice was not important. Whilst most of the interviewees stated that it would be preferable to have an accent that was specific to their country, many participants reflected that it was their own personal preference and many of the children did not seem to mind. However, participants also reported that accent was more important if they were working with children who had articulation difficulties since the model provided by the app could not always be used. Participants reported that they muted the volume if the accent was problematic or they provided an additional model with the correct pronunciation of the word. Specific components related to voice and accent reflected that participants would like the voice to have a human quality rather than a 'robotic' sounding voice. The accent should be neutral with clear inflections. Many participants reported that children related better to a child's voice than an adult voice.

> *"For me it was important that they used kids voices and that they were very clear, simple language."* [P1]

> *"I tend to use apps in therapy that have children's voices. It's really just me choosing them. I like it from a child's perspective."* [P2]

> *"As a person I don't like the extremely robotic voices. I stay away from apps that use a very fake sounding voice. But I don't really feel like the kids ever cared."* [P5]

> *"If it's a very strong American accent on the app. That is when you have to sort of compromise. So you might have to turn the sound down on it…….Having a child voice would be lovely."* [P10]

"It can be very annoying if it's a very American accent. One of the apps I use, you can have a child or an adult. Trying to sort of mirror the child's voice can be quite useful. Sometimes the kids seem to actually like the American voice better! So I am starting to think, actually am I making decisions around the voice and the children aren't really following?" [P11]

"I really get excited when I can get something that I feel is going to be familiar to the children." So if I can get an Australian accent……I get really excited because I think that's going to make it a little bit easier. I think the kids do cope better, but saying that, we have so much American on TV…..I don't think the kids even notice it because they are so immersed in their television culture anyway. I think it's my personal preference." [P13]

"Most of the children find it quite easy to understand an American or an Australian voice. And if they give me /ˈkæsəl/ I'll feedback /ˈkɑːsl/ (castle) for them. I'll facilitate the South African pronunciation or structure" [P15]

4.11 Features of Apps Impeding Intervention

4.11.1 Background sounds. The aspect that most participants reported as interfering with therapy related to the background music or sound effects made by the app. Participants reported that sounds could be distracting to the children and sound effects such as buzzers could be demotivating. This highlights the importance of being able to turn on and off features.

"There's apps that don't let you turn off the music and I can't use some of those with them, because the music might make them crazy." [P4]

"…If you could turn off certain features so that you could change the app so that it has less sound effects, or you could turn off the background music." [P5]

"I am the type of therapist that turns off the big 'boom bong' kind of noise if I have got the option to. So that the kid's don't get that kind of negative response." [P12]

" …every app that has a yes/no answer and a buzzer that goes 'mah' when the answer is wrong. I never use that. When I can disable that feature, I do that straight away." [P14]

4.11.2 Screen elements. Many participants reported that too much visual stimulation or information could be distracting for children. This often resulted in participants abandoning apps that they had purchased. Visual distraction is an element identified by Mayer's (2003) coherence principle, which states that student's learn better when extraneous words, pictures and sounds are excluded.

> *"…….a lot of just sort of silly random actions. Things just shake or just are…They are just distractors. And the kids are just wanting to just touch random things to see what they'll do without going any further than that…..There is too much busy-ness. There's too much stuff going on. "* [P1]

> *"….I've bought apps and I've realised this is too much reading for the student…..The big thing is just confusing interface, too many words visually."* [P2]

> *"…if they are very busy, or very visually stimulating, they might actually be too distracting for the children."* [P9]

> *"When it's all bells and whistles…. I tend to find if it just goes along and lights up the words in the sentence and then you turn the page, that's fine. Bus as soon as you can touch something and it explodes, then they get suck on that because that's the fun thing and then we lose what we are doing."* [P11]

4.11.3 Slow pace. As previously mentioned, participants reported that being able to control the pace of an app facilitated their intervention. In contrast, participants also reported that when they were not able to control the pace of the app, this impeded their ability to use an app successfully. The participants predominantly reported on the slowness of apps that resulted in them being more cumbersome to use.

> *".....they're just pushing and it keeps clawing through the different questions. Yes, that impedes my therapy because now they've learned nothing. There is no reason for them to…."* [P3]

> *"I guess I also like apps that are quick. You can get a lot of repetition in."* [P2]

> *"You may have to jump through a lot of hoops to get through it. ….Every time I want to go in I have to re-programme the goals for each child, so the setup can impede it."* [P4]

> *"Sometime the speed or the way that the app is…If you are locked into something, you've got to go through to the end for example."* [P10]

4.11.4 Reduced interaction and generalisation. Many participants highlighted the interaction between the therapist and the child as being an integral part of the therapy process. Conversely, participants also reported that whilst apps were useful for obtaining multiple examples for practice, it was important to be aware the communicative interaction, and being able to apply the skills targeted using the app to other situations.

> *"They get involved in the app and they just want to play the app and they don't want to talk to you any more."* [P5]

> *" Kids might only want to use that app and they might not be able to generalise other situations."* [P6]

> *"Kids just learn them because they are quite repetitive, they are quite rigid and so for that reason I think yeah they can achieve it in that app, but they might not achieve it in another."* [P8]

> *"There are some children where the app becomes everything. I think that while it might be a really great learning tool, I then am still concerned about transfer from that learning tool to other things. I think also if you lose that social engagement and that engagement with the child……"* [P12]

4.12 Summary

The results from this study reflect that SLPs are using apps as a tool to facilitate their intervention with children. One of the primary reasons for using apps related to engagement and motivation. The use of the iPad allowed participants to target their intervention goals in a number of different ways and incorporate numerous therapy techniques to facilitate learning. The findings showed that participants value the portability of the iPad, which contains

multiple therapy activities. To this end, participants reported that apps provide them with an additional resource for therapy particularly when they worked in a variety of clinical settings.

The findings show that participants are using apps as an adjunct to their traditional therapy but they do not feel that their role has changed. Thus, participants felt that it was important that they facilitated use of the app with the child. Accordingly, social interaction and communicative interchanges were noted to be important during therapy. In addition, participants noted their concerns regarding screen time for children and the need to implement guidelines in this area.

Some participants used information from the app itself in order to obtain evidence-based information regarding the app and many participants noted the need for research regarding apps for intervention. However what was striking was that even though participants felt that EBP was important when using an app for intervention, they are not actively seeking evidence when using apps. The findings show that participants are utilising apps as a tool and are applying their knowledge of clinical practice in order to use this tool. Participants are obtaining information about apps primarily through word-of-mouth, social networks and blogs. They are not making use of clinical feature matching in order to select an appropriate app and many abandoned an app when the app contained features that impeded their intervention. Most participants felt that further training regarding effective use of apps for intervention was needed. On-line training was the most preferred method for further training.

The findings showed that SLPs use apps primarily as a reward in therapy or to reinforce a concept. In addition, participants felt that some apps enabled them to reflect on the therapy process by identifying targets that were addressed by the app that they had not considered, or by assisting them in breaking down therapy targets into manageable goals.

Slightly more than half of the respondents felt that it was important to have a reward

incentive in an app. A choice of reward games was preferred followed by a single reward game. As mentioned previously, many participants reported that using an app itself was a reward for children.

Participants are using specific language apps as well as game-based apps in order to address their therapy goals. Many participants adapted or repurposed apps in order to address therapy goals not specifically stated by the app. The manner that participants were using apps was based on their approach to intervention; some participants used a more play-based approach whilst others used a more structured approach.

Respondents noted a number of features of apps that facilitated or detracted from their intervention. Many of these features related to multi-media learning whilst some of the features related to the therapist's ability to incorporate clinical intervention techniques whilst using apps. Most importantly, respondents felt that it was important for an app to have different developmental/difficulty levels. A child-friendly theme was important so that children identified with the content. Animation was felt to be most beneficial in engaging children, but respondents also noted that too much movement and extraneous information and pictures were detracting. Buzzer sounds and red X's reflecting incorrect answers were noted to be demotivating for children.

The ability to control the pace of the app was felt to be important to allow for respondents to adapt to the needs of the child. Some children required a slower pace to allow for additional processing time, whilst others required a faster pace in order to target multiple repetitions of the target. Similarly, when a child made an error, respondents felt it was most important that they could repeat the item. This allowed them to provide intervention at the child's level. Multiple examples for practice, different learning modalities, and interactivity with the app were features that were reported to be important in order to generalise skills

learnt. The ability to save progress and customise settings for different users was also important to respondents. This enabled them to obtain a more objective perception of the child's progress in therapy. Additionally, data tracking features were important to respondents with large caseloads. Respondents also reported that a record feature was beneficial to facilitate self-monitoring and generalisation of skills.

Respondents preferred to have the option of different accents available, but many respondents reflected that it was their own preference rather than the child's preference. Different accents were most important when respondents were addressing articulation difficulties. Respondents also felt that a child's voice was preferable to an adult voice.

Despite the fact that the findings from this study showed language apps to be most prevalent, qualitative information reflected that participants appear to favour articulation apps. It is possible that the nature of the survey question, which referred to language apps, skewed the results. However, this area requires further investigation.

The findings from qualitative interviews elucidated on the information obtained for the quantitative data. The discussion that follows will integrate the findings.

Chapter 5: Discussion

5.1 Overview of the Study

Speech-Language Pathologists (SLPs) are using iPad apps to facilitate their intervention with children who present with speech and language difficulties. However, there is limited research on using this technological tool to facilitate intervention with children who have language difficulties. This international study examined the features that SLPs regarded as important when selecting and using apps for language intervention. The study also investigated the reasons why SLPs were incorporating apps, how they were using apps in their interventions and the manner in which they obtained information about apps.

The discussion provided in this chapter links the findings presented in the previous chapter in relation to the objectives of this study with reference to the literature reviewed to elucidate on the findings.

This study demonstrated general consensus regarding app use and features of apps among English-speaking SLPs in different countries. The findings showed that participants are selecting apps for language intervention unsystematically. While participants identified many features of apps that facilitate or impede learning, they did not appear to consider the specific ingredients or the underlying mechanisms that effect change on the target. Consequently, they are not harnessing the use of apps to their full potential.

The findings were critically evaluated against a background of EBP that considered the clinical expertise of the SLPs and the external scientific evidence that form two of the three components of the EBP triangle. Alt, Meyers, and Ancharski (2012) state, “one of the most useful and flexible types of evidence is an understanding of the principles that underlie the therapy techniques chosen” (p. 487). Taking this notion further, the responses that were given by the participants were examined against the components identified in Turkstra et al.’s

(2016) model of RTT. What was evident was that the participants did not engage deeply with any of the characteristics that Turktra's model presents; instead, they identified the apps as being useful adjuncts to therapy. The main finding reported was that the children found apps to be motivating. The obvious gap in the participants' evaluation of the use of the apps as treatment options was the lack of engagement with the theoretical underpinnings of treatment. The need for clinicians to engage with what constitutes 'treatment' and how to translate the ideal of EBP into every-day therapy provision remains a challenge, and this challenge was highlighted by the findings of this study.

Perhaps had the survey been worded more specifically to identify the participants' theoretical engagement with multimedia learning and the mechanisms underlying app usage, different information may have been obtained. However, participants were offered opportunities to expand on their responses, but as was mentioned in the results section, very limited information was yielded from the open-ended questions and the majority of the participants did not expand on their responses when given the opportunity to explain their choices. In addition, the information was not obtained from the semi-structured interviews. It is therefore likely that the participants do not engage with the theoretical underpinnings of treatment choices when selecting to use apps.

The use of technology for learning should also account for principles of information processing, multimedia learning and learning principles. While the mechanisms of action related to learning and information processing are particularly difficult to characterise precisely (Turkstra et al., 2016), the clinician may be able to infer these mechanisms based on the client's responses. Thus when considering "the causal relations among the ingredients, mechanisms of action and targets" the therapy methods that are most effective for the treatment targets can be used (Turkstra et al., 2016, p. 6).

5.2 Reasons for the Adoption of Apps by the Participants

Respondents are adopting the use of apps for many of the same reasons cited in the literature. These include, motivation and engagement, a play-based intervention approach, the ability to easily transport equipment, an additional therapy resource, and the ability to provide opportunities for repetition and practise.

5.2.1 Motivation and engagement. Respondents reported that apps are inherently motivating and children perceive this technology as engaging (Crichton, Peglar, & White, 2012; Diemer, Fernandez, & Streepey, 2013; Hutchison, Beschorner, & Schmidt-Crawford, 2012; Muis, Ranelluci, Trevors, & Duffy, 2015; Pachler, Bachmair, & Cook, 2010). The importance of motivation in order to learn is well documented in the literature (Ehrel & Jamet, 2013; Eisenberg, 2013; Moos & Marroquin, 2010) particularly in relation to computers and game based learning. Research on the use of tablet technology as a motivational tool to support learning outcomes is positive in the field of education as well as in special needs populations (Rodríguez & Cumming, 2016; Haßler, Major, & Hennessy, 2016). It is therefore unsurprising that SLPs are adopting technology in order to engage and motivate children.

An additional consideration is that children with difficulties often need to be engaged in several ways before new information is learned (Eisenberg, 2013; Mundy, Sigman, & Kosari, 1990; Powell, Burchinal, File & Kontos, 2008; Rivera et al., 2013; Tomasello & Farrar, 1986). Participants reported that the use of apps was an additional means to engage children. However, the participants emphasised that the use of apps did not replace the SLP in their intervention.

As discussed, whilst engagement and motivation are important for learning and intervention, the prominence of engagement and motivation as a rationale for selecting apps

for intervention, suggests that participants do not consider the underlying theory when choosing apps for intervention. Even if a child is engaged and his or her attention is focused on the activity, it does not signify that they are learning more effectively (Hirsh-Pasek et al., 2015; Sorden, 2005). It is likely that use of an app will result in improved engagement and motivation, however this will not necessarily result in a change in the target unless the clinician is able to determine the specific ingredient/s that are used in the intervention and infer the mechanisms that modify the target.

5.2.2 Play-based intervention. In discussing their implementation of apps in therapy, many participants described their approach as play-based and therefore the use of apps facilitated this type of intervention approach. A play-based approach to language therapy (Girolametto, Pearce, & Weitzman, 1996; Lifter & Bloom, 1989; Lantz, Nelson, & Loftin, 2004; Owens, 2010) particularly with younger children has been advocated by speech pathologists for decades because of the inherent relationship between play and language, play and cognition, and play and social interaction (Cordier et al., 2016; Lifter, Foster-Sanda, Arzamarski, Briesch, & McClure, 2011). Fernandes (2011) notes that the play-based nature of speech-language pathology may have contributed to the uptake of apps into this field.

However, when considering the play-based nature of app use, participants reported that they used apps in the same manner as any other toy without consideration of factors that may impact on learning. Difficulty transferring learning may occur at a perceptual level in young children or on a conceptual level particularly in children with language disorders (Barr, 2013). Zack, Gehardstein, Meltzoff, & Barr (2013) demonstrated even when provided with language cues, young children may have difficulty transferring learning from two-dimensional to three-dimensional objects.

Proponents of the use of technology for play such as Gee (2003), note that technology

enables activities that are too costly, or difficult to implement in the classroom. Gaming expertise is linked to executive functioning, self-monitoring, pattern recognition, problem solving, decision-making, qualitative thinking, and superior short-term and long-term memory (Folkins et al., 2016; Gee, 2003). Yelland (2011) emphasises that children need to engage in authentic play with physical objects of the real world. However, she also emphasises that new technologies form part of a repertoire of experiences for young children's learning and therefore cannot be ignored.

What is evident is that playing with physical objects cannot be directly compared to using technology since they are inherently different in their makeup. Although the ages of the children receiving language intervention were not investigated, this highlights some important issues regarding the use of apps with children. Firstly, as noted by new screen guidelines from the AAP (2016), screen time with touch-technology cannot be equated with passive television watching. However, the plethora of screens in many children's environments cannot be ignored. Secondly, even though respondents were using apps for play-based learning, there is a great deal of evidence that demonstrates that guided play is beneficial when the learning context is designed in a purposeful way (Fisher, Hirsh-Pasek, Newcombe, & Golinkoff, 2013; Massey, 2013). Respondents were very clear that even though they used apps like any other toy, the nature of the interaction was not haphazard and was based on the language goal. Finally, it is important to consider the intrinsic relationship between language, cognition, and play since difficulty transferring knowledge from two-dimensional objects to three-dimensional objects may be exacerbated in children with language disorders. Thus, the age and developmental level of the child must be carefully considered when using apps for learning, as children of different ages and developmental levels may respond differently.

While technology and learning can be integrated, the two modes of representation (technology and real objects) must be separated, taking into account the different ingredients and mechanisms of action that each contribute to learning.

5.2.3 Transportability. The participants reported that they often have large caseloads and many participants indicated that they work in multiple settings. This required them to carry equipment from one setting to another. The use of apps allowed the participants to have a variety of materials that was easy to transport. Furthermore, the transportability of the apps enabled them to be used in multiple locations. For example, many participants travelled to the clients' homes in addition to working in a school or private practice setting. Models of m-learning emphasise that learning can take place in numerous environmental and social settings (Crompton, 2015; Sharples, Taylor, & Vavoula, 2010). Sharples, Taylor, and Vavoula (2010) note that the context is not unique to the location that the learning occurs, but is created through the interaction between the technology and the learner. There is a great deal of support in the literature for home-based language intervention programmes (Wake et al., 2013) and the ability to easily transport equipment may facilitate increased service delivery by SLPs.

While the results of this study reflected that it is important that the SLP must facilitate the use of apps, the notion of m-learning implies that learning is not confined to a given time and place. Additionally, identification of the treatment ingredients could potentially be used to describe treatment in terms of a home-programme. This implies that use of apps may be beneficial for home practice when facilitated by an adult. Support for home practice using iPad apps has been noted in patients with aphasia (Kurland et al., 2014; Choi, Park, & Paik, 2016; Stark & Warberton, 2016) and the potential of using apps for extended practice for children with language difficulties warrants further investigation. This may potentially result

in improved learning and increased transfer of targets.

5.2.4 Apps as an additional therapy resource. The participants reported that the apps are simply another mode of presentation. However, they did not consider the theoretical underpinnings of the 'useful', 'additional" mode of presentation. What they reported, instead, was that apps were an effective means of providing an additional learning modality to target a skill.

This raises an important issue regarding adherence to therapy goals. Providing additional modes of presentation may be useful, but conversely, without an understanding of the treatment theory regarding how the ingredients are supposed to effect change on the target, it is also possible that using an app as an additional mode of presentation is not efficient for the client. Repeated practice of a target may not necessarily result in improvement of the language target. Therefore, unless SLPs define the ingredients of treatment, they cannot measure whether the treatment is contributing to change in the target behaviour. Simply providing an additional mode of practice fails to consider the ingredients and mechanisms that effect change on the target.

The participants indicated that using apps allowed them to artificially create opportunities for practice. This finding provides support for well-documented intervention techniques. Firstly, changing the instructional context enhances learning because the learning becomes linked with a greater range of contextual cues (Bjork, 2011). Secondly, it is important to create learning opportunities using different methods so that learning is not restricted to a particular context or learning condition (Bjork, 2004 as cited by Kamhi, 2014; Sorden, 2005). Thirdly, providing models that vary in intensity and specificity is a critical component of therapy (Kamhi, 2014). Lastly, as Ricks and Alt (2016) demonstrated, providing additional linguistic input and contrasts can make the meaning of the word more

salient. When this is provided together with visual support, there is less demand placed on the working memory in children with language difficulties. This, in turn, facilitates learning of the target. Many apps provide varying amounts of linguistic input and contrastive features at different levels. For example, an app can easily contrast a big, red car, a big blue car with a small red car and a small blue car. In addition, this feature can be extended to multiple examples. The use of apps may therefore serve as an important ingredient and mechanism for language intervention with children.

5.2.5 Repetition and multiple examples. An important part of intervention requires creating multiple opportunities for production of the target. Consistent with principles of language intervention, the participants reported using apps because they provide many examples of the target items. This saved time provided opportunities for the children to learn more targets in a given period and provided multiple opportunities for learning the target items as well as opportunities for repetition. Respondents also reported that repetition also facilitated generalisation of the target. When applying principles of learning theory to children who have difficulty learning, Ricks and Alt (2016) note that, "children with word-learning challenges tend to need more examples than typically developing children do to learn" (p.186).

The use of focused stimulation, which uses repeated practice of the target utterance is widely reported (Girolametto, Pearce, & Weitzman 1996; Wolfe & Heilman, 2010) and therefore supports the use of repeated practice. In her review of the evidence related to the efficacy of grammar intervention, Ebbels (2014) notes that irrespective of the technique used to elicit the target response, the aim of the intervention is to make target forms more frequent, which is hypothesized to help the child identify grammatical rules and give the child practice at producing forms they tend to omit. Roth and Worthington (2015) emphasise that effective

intervention must consider treatment efficiency of the intervention. This does not only relate to the dose of intervention but the amount of intervention given within the setting.

Whilst respondents were sensitive to the dose and amount of intervention when using apps and only used them for a limited period within the session, they did not appear to consider the efficiency or quality of the intervention. Although respondents reported that they were targeting a specific language structure using repetition and multiple examples, they did not identify the specific ingredients used to address the target or possible mechanisms that effected change on the target. Therefore, using apps may not necessarily be contributing to treatment efficiency. In order to replicate findings, it is necessary to isolate the specific ingredients that facilitate change in the target. This will allow future research to deliver equal amounts or measures of the ingredients. In turn, this will contribute treatment efficiency.

5.3 How SLPs are using Apps in their Interventions

5.3.1 Apps as a tool. Whilst participants emphasised that apps were a tool, and not an intervention technique, this finding provides additional validation to the notion that respondents are not taking into consideration features of multimedia learning to support their intervention. As participant 14 stated, "*I use them like I would a toy or a game……It's something you would have to manage."* As elucidated previously, an app cannot be directly compared to a tangible three-dimensional object such as a toy car, or doll and thus it is important to identify the factors that this tool can contribute when used for intervention.

Kamhi (1999) reported that many SLPs described their approach to intervention as eclectic and justified their use of an approach to intervention as "because it worked" (p. 93). However, Lum (2002) cautions that there is a growing market of packaged speech-language pathology therapy materials and programmes. These need to be vetted to establish the quality,

relevance and effectiveness of the product. For example, applications and sites such as Pinterest (www.pinterest.com) Teachers Pay Teachers (TPT) (www.teacherspayteachers.com) and Instagram (www.instagram.com) are used to share and market products developed by educators and SLPs. These are often packaged materials developed to address specific target areas. However, these are no established guidelines for the quality of these products or resources, and it remains the discretion of the SLP using the product to establish the quality and effectiveness of the resource based on their clinical experience and expertise.

As discussed in Chapter two, one of the key components of EBP is clinical expertise/expert opinion. Brackenbury, Burroughs, and Hewitt (2008) note we cannot conclude that an intervention has no merit because it has not been systemically evaluated. It is, therefore, imperative that until such time that there is clinical evidence to support or refute the use of a treatment ingredient, we should not abandon its use. Thus, the acknowledgement of practice-based evidence is valuable until more clinically relevant information becomes available (Justice, 2010). The RTT may enable clinicians to examine their interventions more critically so that practice-based evidence can be integrated with EBP.

5.3.2 Re-purposing of apps. Respondents reported that it was important to be able to use an app for a variety of purposes. Many respondents reported using game-based apps, which they adapted to target language goals. However, in this instance too, respondents are selecting game based apps by word-of-mouth and are not considering the types of intervention strategies supported by the app and how apps can be adapted/utilized for language learning (Procter & Wang, 2015). Therefore even though respondents emphasised that their therapy is goal driven and not guided by the app, Cherner et al., (2014), and Procter

and Wang (2015) recommend that SLPs and educators need to be aware of the goals targeted by the app.

However, Turkstra et al., (2016) point out that the mechanisms of action and ingredients influence the selection of targets. The respondents emphasised that the goal of intervention is an important consideration for treatment description. However, in labelling the treatment in terms of the problem rather than in terms of the specific ingredients used to treat it, may result in different treatment strategies being melded. Consequently, it may be difficult to identify the active ingredients of treatment and the mechanisms underlying them. For example respondents reported that apps were beneficial for "*leading conversation and language"; "keep the kids talking while they are using the app and ask the right questions to get them to use language."* However, they did not specify the specific targets of the conversation or language. An additional consideration is that treatment strategies need to be defined in terms of whether they are compensatory or restorative. A language disorder that is a result of a brain-injury should be specified differently to a language disorder that may be due to a developmental delay since the treatment components and ingredients necessary to change them may be different (Bishop et al., 2016).

It is possible that SLPs are repurposing apps for multiple goals because they are able to engage the child in tasks that they would not ordinarily be as engaged in. Additionally, game-based apps may provide well-defined roles and this may enable the clinician to prompt and elicit language that is specific to the therapy target. An important part of intervention is to actively engage the child in meaningful socially interactive experiences and provide appropriate feedback based on the child's output. The ability to engage children more readily using apps potentially increases learning (Alt et al., 2012; Hirsh-Pasek et al., 2015). However, as previously noted, in order to integrate EBP with practice-based evidence, it is

equally important to connect the ingredients, mechanisms, and outcomes of intervention so that clinicians can articulate what they are doing in therapy more effectively.

5.3.3 Pace of progression. A predominant finding from the study was that therapists felt it was important to control the pace of the app. This enabled them to provide necessary intervention in the form of scaffolding, modelling, direct instruction, and repetition if the child made an error. Mayer's (2003) pacing principle states that better transference occurs when the learner controls the pace of learning rather than the programme. A self-paced presentation of text and pictures within the multimedia instruction can be helpful to understanding, because it may decrease the cognitive load and allow students to take the time they need to engage in deeper processing (Mayer & Chandler, 2001). Kühl, Eitel, Damnik, and Körndle (2014) demonstrated that self-pacing led to longer learning times but resulted in better retention and transfer of knowledge. When this principle is applied to therapeutic intervention using apps, SLPs reported that it is their role to control the pace of the app so that the appropriate intervention can take place.

5.3.4 Interaction during app use. Respondents were acutely aware of the nature of interaction between the SLP and child when using apps. Respondents considered both the communicative interchange such as turn taking, sharing and commenting, as well as the non-verbal and pragmatic elements of communication such as eye contact as being an integral part of the therapy process. Similarly, Park (2011) notes that mobile technology is unique because of its ability to support effective face-to-face communication. Respondents noted concerns around the use and impact of screen time that is consistent with global concerns (Christakis, 2014; Shifrin, Brown, Hill, Jana, & Flinn, 2015), but emphasised that educating parents and caregivers was imperative. The findings highlight the importance of education in terms of using apps effectively so that it does not interfere with communication. The role of

the SLP may be vital in educating parents and caregivers in using apps more effectively to promote communication and negotiate an appropriate balance of screen time. The recent AAP screen-time guidelines for children (October, 2016) take into account multimedia use in constructive and collaborative ways. What is evident from these findings, is that central to the use of technology is the mediation of communication.

5.4 Revised Model of m-learning

Given that interaction is viewed as a key mechanism for learning (Guernsey, 2016), the role of the SLP, parent or educator is central to intervention using apps. Language is embedded in a social context, which determines the type of communication that is used (Girolametto, Greenberg, & Manolson, 1986; Owens, 2015). In addition, a theoretical understanding of the principles of multimedia learning is important to understand the principles that guide learning with apps. However, it is equally relevant to consider the characteristics of the learner and the context in which learning occurs. The researcher therefore proposes a revised model of m-learning for speech-language intervention. Accordingly, underlying all learning interactions, conversation and social interaction must be explicitly specified. This emphasises the important role of communication that must be fostered between the child using the mobile-device and the SLP (or educator, parent). In considering m-learning, the pragmatic and non-linguistic roles of communication cannot be ignored. These include eye-contact, turn-taking and sharing. The revised model is shown in Figure 19.

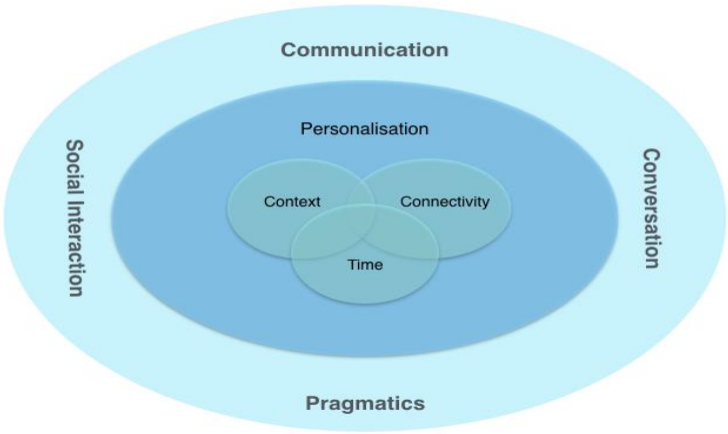


Figure 19. Proposed revised model of m-learning including communication, social interaction, pragmatics and conversation. Adapted from Crompton (2015)

In order to facilitate the above-mentioned aspects of communication when using apps, there are a number of factors that should be considered. The physical orientation, placement and position of the iPad should be taken into account so that opportunities for communication are not impeded. The iPad should not obstruct eye contact between the SLP and the child, and pragmatic and social conventions regarding use and turn-taking should be established.

5.5 SLP Selection of Apps

5.5.1 Evidence-based practice. Despite positive attitudes regarding EBP as well as a belief in, and knowledge of EBP, participants are not selecting on clinical feature matching, nor are they incorporating information on effects of multi-media learning when selecting and using apps for intervention. There may be a number of reasons for the lack of integration of EBP that are discussed below.

Firstly, respondents may be adopting a consensus-based information approach (Lof,

2011). Many respondents reported that they made use of discussion forums in order to obtain the clinical perspective of other SLPs. The impact of social media and on-line discussion forums may influence group dynamics. Consequently, other clinicians may feel they are not 'up to date' with technology and so they concede and begin using apps without full consideration of the evidence and theory underlying the use of apps.

Secondly, a possible reason why respondents are not incorporating EBP into their selection of apps may be because of a theory-practice gap (Caty, Kinsella & Doyle, 2016). Caty et al. (2016) note that while effective practice needs to be informed by formal theory, the complex and ever changing nature of practice also necessitates the development and understanding of other kinds of theories relevant for professional practice. This is particularly relevant to SLPs using apps for intervention since knowledge of information-technology and multimedia does not typically form part of traditional intervention approaches.

The above factors highlight the need for a model that can assist clinicians in integrating practice-based evidence with evidence-based practice. Respondents were aware of the lack of research regarding app use for language intervention. In addition, the paucity of research impeded their ability to integrate science and clinical practice to make treatment decisions (Justice, 2010). Consequently, respondents are relying on practice-based evidence (Barkham & Mellor-Clark, 2003) to support their decisions. Similarly, McCurtin and Roddam (2012), and Goldbart, Chadwick, and Buell (2014) found that the majority of SLPs do not draw on research evidence to support their clinical decision-making. Zipoli and Kennedy (2005) found that clinical experience and the opinions of colleagues were the most frequent sources of information by SLPs.

An integral consideration when implementing EBP is the ability to objectively evaluate the available external evidence in the context of individual client (Fey & Justice,

2004; Justice, 2010; Karthikeyan & Pais, 2010). The value of the RTT is brought to the fore by the disparities exhibited by the respondents. Not only will the use of this model facilitate the details of treatment, but it will also enable clinicians to infer the mechanisms of action that result in change on the target. This will encourage clinicians to be more sensitive to different learning theories, including multimedia learning and the evidence supporting their implementation.

5.5.2 No use of existing rubrics. The results from this study support claims in the literature that the prolific number of apps available makes it difficult to evaluate apps. Whilst there are numerous frameworks that have been put forward to review educational apps, there is no consensus in the literature. Consequently, the respondents' selection of apps is not guided by using frameworks or rubrics.

The absence of an available, easy to use framework may also be a contributing factor to the lack of feature matching when selecting apps for language intervention. With regard to the development of their educational app rubric, Lee and Cherner (2015) note that practical use of this rubric by classroom teachers is questionable since it would require a great deal of time learning how to use it appropriately and there is an inherent subjective bias when using a rubric. Thus, adaptation of educational rubrics for SLPs may prove to be cumbersome and ineffective. It is therefore proposed that a feature-matching checklist may serve therapists' needs more effectively in order to facilitate their selection of apps. A feature-matching checklist will allow therapists to select apps based on the presence/absence of features. This in turn will allow the identification of treatment strategies supported by features of the apps, and enable an understanding of the mechanisms of intervention.

It is apparent that the interactive manner that SLPs use apps for intervention implies that their approach to app use cannot be directly compared to app use in a classroom

environment. Therefore, existing rubrics cannot be adapted for current practice. Rather, the ability to select apps based on features will allow clinicians to become more discerning in their selection of apps. This in turn will allow more robust clinical information in terms of the features that support language intervention and facilitate much needed research in the field

It is therefore proposed that a feature-matching checklist may serve SLPs' needs more effectively in order to facilitate their selection of apps. A feature-matching checklist will allow SLPs to select apps based on the presence/absence of features. This in turn will allow the identification of treatment strategies supported by features of the apps, and enable an understanding of the mechanisms of intervention.

5.6 Features of Apps

Respondents identified a number of design parameters in an app that facilitated their intervention with children with language difficulties. Specifically, respondents reported that animation and movement was most likely to engage children. Thus, despite the conflicting literature (Betrancourt & Berney, 2012; Paik, 2010; Schwan & Riempp, 2004; Tversky, Morrison, & Betrancourt, 2002; Rieber, 1991) on the effects of animation on learning, respondents reported that animation contributed significantly to engagement and motivation. In support of the literature, respondents also noted that complex animations could be distracting for the child. This interesting finding suggests that the complexity of the animation may impact on the child's ability to process information effectively and result in distractibility. Further research into the type of animation that contributed to or detracted from intervention may provide additional useful information in this area.

Related to this, respondents reported that when using apps for language intervention a child friendly theme was preferable. The nature of what constituted a child-friendly theme

was not investigated. It is postulated that in order for the app to be appealing to children and for children to be able to relate to the content more effectively, a child-friendly theme was important. Support for this view comes from Fletcher-Watson, Pain, Hammond, Humphry, and McConachie (2016) who used a participatory model to design an app for young children (below 6 years) with ASD. They found that participants preferred game characters that were children and familiar background settings. Drawing from the results of this study as well as learning theory, it is suggested that use of familiar stimuli can facilitate learning and unfamiliar stimuli has the potential to inhibit learning (Ricks & Alt, 2016).

Respondents noted that screen elements such as too many words or too many pictures were distracting and interfered with intervention. In addition extraneous sounds or pictures detracted from the therapy goals. The respondents reported that additional sounds and interactive pictures resulted in children becoming too involved in the app and consequently did not engage as effectively with the therapist. These findings align with the coherence principle of multi-media learning, which states that students learn better when extraneous words, pictures and sounds are excluded (Mayer, 2003; Mayer & Moreno, 2003). Falloon (2013) found similar results, but it must be noted Falloon's study examined children's independent interaction with apps. The presence of the therapist during the interaction may facilitate and mediate the child's interaction (Sandvik et al., 2012). Never the less, these factors should be considered when using apps for intervention.

Interactivity was an important feature of apps and respondents reported that the interactive nature of the touch screen could be used to facilitate communicative interaction. However, the respondents expanded on this by elucidating on the nature of the interaction. Importantly, they noted that their therapy goals were of primary importance. For optimal learning to occur the interaction needed to take into account the interaction between the child,

the app and the SLP. This view is supported by models of m-learning (Crompton, 2015; Sharples, Taylor, & Vavoula, 2010). Hirsh-Pasek et al. (2015) note apps can incorporate social interaction by encouraging collaboration, turn-taking, shared experience of viewing and discussion and prompts for conversation.

The current multimedia guidelines from the AAP (October 21, 2016) note that interactivity, as an aspect of using apps is not a simple concept. Similarly, many respondents expressed reticence in terms of advocating the use of apps to parents because of the complex nature of the social interaction required. Hirsh-Pasek et al. (2015) point out that when using apps "the social interaction has to be of a high enough quality that it does not detract from the learning situation" (p. 18). Whilst some respondents reported that their clinical knowledge enabled them to incorporate social interaction, many felt that parents may not be able to do this effectively. Respondents also reported that if they were to receive training on using apps for therapy, this needed to be more 'hands-on' with examples on how to incorporate the use of apps most effectively into practice. Interestingly, despite the need for hands-on training, most participants reported that their preferred method of training was via webinar. Access to information and training anytime and anywhere, reflects the current trend in mobile learning and access, and offers possibilities for supporting professional growth and development.

Data from the survey reflected that the narrator's voice/accent was moderately or very important and most respondents reflected that they would like to have the option of a different voice/accent in an app. However, qualitative findings from the semi-structured interviews reflected that the preference for a different accent was based on the respondent's preference rather than the child's preference. Thus, whilst respondents felt that it was important for the child to identify with the narrator's voice in an app, they also noted that it was important for the child to be able to attend to information in an accent that was different

to their own accent. To this end, respondents suggested that a child voice was preferable to an adult voice, a neutral accent was preferable and the gender of the voice was not important. The ability to identify with the voice has been shown to facilitate learning (Atkinson, Mayer, & Merrill 2005; Mayer, Sobko, & Mautone, 2003) and learning with familiar accents led to better performance than learning with foreign accents in both adults and children (Falloon, 2013; Mayer et al., 2003; Newton & Ridgeway, 2016; Rey & Steib, 2013).

Harte, Oliveira, Frizelle, and Gibbon (2016) conducted a review of the literature investigating the effect of an unfamiliar accent on language comprehension in typically developing children and in children with speech difficulties. Whilst they noted methodological inconsistencies in the literature, there was overwhelming evidence that an unfamiliar accent has an impact on typically developing children's language comprehension. Kühl et al. (2014) found that reducing the quality of instructional material on a perceptual level can be detrimental to learning with multimedia and many children with language difficulties present with perceptual difficulties (Leonard, 1998) that may affect the ability to attend to auditory information provided by an app. This has clinical implications in terms of using apps with an unfamiliar accent particularly since many of the apps have an American English accent.

Thus whilst the interviewed respondents diminished the effect that the voice and accent had on the performance, these effects may be significant, and must be considered when using an app for intervention. Many respondents reported that they made adaptations when the child experienced difficulty understanding the voice or accent used in the app. They therefore adapted the app by turning down the volume or by repeating the information for the child if they encountered difficulty. Respondents reported that accent was more important when the child had articulation difficulties. Whilst no data were obtained regarding use of

apps when treating children with co-occurring articulation and language difficulties, this information could provide more detail on the importance of accent when using apps.

Slightly more than half of the respondents (53%) reported that the inclusion of a reward in an app was important and a choice of reward games was preferred by 37.3% of respondents. This finding correlates with the literature that shows that external rewards are particularly beneficial to increase motivation particularly on tasks where children experience difficulty (Cameron, Banko, & Pierce, 2001; Filsecker & Hickey, 2014; Lepper, Henderlong, & Gingras 1999). Folkins et al. (2016) note that speech-language therapy often incorporates extrinsic markers of success, and encourages intrinsic rewards and motivation. Fletcher-Watson et al.'s (2016) study recommended the use of a reward token system for children with ASD, but they also noted that children had differing reward preferences. Thus although the respondents felt that a reward in an app was important, many respondents also noted that using an app was a reward in itself for many children. This suggests that respondents make use of some extrinsic rewards in therapy but they are sensitive to incorporating a reward system into a therapy design that is "ultimately dependent on the intrinsic rewards inherent in a client's successful behaviour" (Folkins et al., 2016 p. 117).

Findings from the present study showed that it is important to be able to save data in an app so that progress can be monitored. Related to this, the respondents reported that it was important to have different user profiles for different children. Ok et al. (2016) emphasise that the ability to monitor progress is integral to any intervention in order to provide on-going, accurate recording of student performance. Although many respondents reported that they monitor the child's progress within the session, they reported that their reflections were not always accurate. The ability to save progress enabled them to obtain a more objective account of the child's performance on the task. This encouraged them to reflect on their

therapy goals and tailor future goals to meet the child's needs.

More than half of the respondents were from USA where speech-language therapy services are provided within the school system based on the child's performance on standardised tests. Additionally, Response to Intervention (RtI) models employed in many American states, incorporate continuous monitoring to ensure that student progress is well documented (Berkley, Bender, Peaster, & Saunders, 2009). Since none of the participants identified the use of multimedia learning as a potential benefit to learning, it is possible, that some participants are choosing to use apps in order to ease their work burden, rather than considering the implications of using multimedia learning.

Respondents reported that multiple examples for practice, multiple learning modalities, and repetition were important features of an app. These findings are consistent with what the literature describes as 'what works in therapy' (Law, Roulstone, & Lindsay, 2015). The use of apps allows SLPs to provide children with different examples of a feature in order to learn a pattern rather than individual items (Frymark, Venediktov, & Wang, 2010; Hsu & Bishop, 2014; Kiernan & Snow, 1999; Ok et al., 2016; Ricks & Alt, 2016; Savage, Lieven, Theakston, & Tomasello, 2009; Torkildsen, Dailey, Aguilar, Gómez, & Plante, 2013). Cognitive theorists of multimedia approaches believe that presenting information using mixed modes (modality principle) and providing some prior knowledge of what is going to be taught before the instruction (pre-training principle) is one of the ways to minimize cognitive overload (Mayer, 2003; Mayer & Moreno, 2003). The use of apps to provide additional examples for repetition and practice indicates that the respondents do not use apps exclusively in therapy sessions but as a complementary or additional activity in order to create multiple opportunities for learning and transfer of skills (Eisenberg, 2013; Folkins et al., 2016).

The respondents reported that it was important for an app to have different developmental or difficulty levels so that they could adjust their level of intervention appropriately if a child experienced difficulty or found a task too easy. These findings reflect that intervention is goal based and follows a developmental hierarchy in accordance with language intervention principles. Thus, when these constructs are incorporated together with principles of multimedia instruction the following elements should be considered; (a) the content of an app should allow the task to be broken down into the skills and information that are needed to learn the educational objective (Ebbels, 2014; Ricks & Alt, 2016; Smith-Lock et al., 2015) (b) the cognitive load of the task can be affected by different features of the app (Mayer and Moreno, 2003), (c) within a therapeutic framework, Vygotsky's Zone of Proximal Development and Piaget's concept of scaffolding is facilitated by the SLP (Sorden, 2005).

A number of app evaluation rubrics for education note that error correction and feedback from the app are important features when evaluating an app (Lee & Cherner, 2015; Ok et al., 2016; Walker, 2011). In contrast, this study found that whilst respondents would like immediate feedback from the app if the child made an error, the nature of the feedback was deemed to be important. Thus, whilst many of the app evaluation rubrics in education consider the level of feedback obtained from the app to be important, the findings from this study highlight that the SLP controls the therapeutic interaction and the type of feedback given. These findings are consistent with literature that reports that intervention is most effective when the adult response is contingent upon the child's errors (Juel, 1996; Schuele & Boudreau, 2008). As such, the SLP or teacher should use feedback to focus the child on the critical aspects of the target, as in the use of a recast, where on producing an error, the child is provided with the target response.

Respondents reported that the option to try again was most important when the child made an error. Further investigation into this finding indicated that the respondents saw it as their role to facilitate the correct production when an error occurred in line with the child's ability level. Respondents relied on their clinical judgment in order to identify the type of corrective feedback that the child required. Respondents also noted that the sensitivity of the touch screen resulted in mishits, which were not necessarily errors made by the child. Therefore factors such as reducing the difficulty level and providing corrective feedback were not deemed to be as important to the respondents.

Additionally, many respondents pointed out that red X marks or buzzer sounds when the child made an error were demotivating and impeded their intervention. Fletcher-Watson et al. (2016) found similar results when developing an app for children with ASD. They found that when a child made an error, it was preferable to have no response from the app. Thus, when evaluating the type of feedback that the child requires, respondents reported using their understanding of developmental sequence, intervention strategies and principles, and knowledge of the social and environmental context in which the learning is taking place. Whilst there is limited literature on the type and amount of feedback recommended during language intervention, studies that have shown the reducing evaluative feedback leads to greater long-term retention of motor skills than feedback provided after every trial (Hula, Robin, Maas, Ballard, & Schmidt, 2008). Kamhi (2014) suggests that this principle can also be applied to language learning. Whilst respondents reported that the goal of therapy was for the child to be able to self-evaluate and self-correct in order to facilitate generalization of skills, less than half of the respondents felt that a record feature was important in an app. In contrast, Rodríguez and Cumming (2016) found that all the students in their study enjoyed hearing their voices played back to them and the teachers reported that the record feature could be used in order for students to evaluate why the sentences were correct or incorrect.

The value of metalinguistic training is emerging as an important component of language intervention particularly in older children and language features that are resistant to other forms of intervention (Ebbels, 2014; Zwitserlood, Wijnen, Weerdenburg, & Verhoeven, 2015). Pellerin (2012) states that the use of audio and video recordings makes learning visible and therefore provides a means of self-assessment and monitoring. The availability of a record feature to encourage self-evaluation and metalinguistic awareness is therefore felt to be an important feature in an app. The reasons why respondents did not assign more value to a record feature are unclear.

The results of this study showed that the ability to customise features of an app to meet the child's needs and treatment goals was important. Ok et al. (2016) emphasise that one of the defining characteristic of students with learning difficulties is that they have a mixed profile of learning strengths and weaknesses. Customised settings can provide individualization and reflect each student's unique characteristics and prior knowledge.

The results of this study highlighted that specific features of apps could be beneficial or distracting for the child. The specific features identified by the respondents included turning on/off sounds, music and background noise, turning text on or off, selecting the number of foils when responding and the ability to select the accent of the app. The findings of this study reflected using an app could provide additional support for the child. In addition, the findings highlighted how respondents are adapting apps to target a variety of skills.

These findings resonate with McMillan and Saffran's (2016) study, which demonstrated that when 2-year-old children were presented with novel words together with background noise that simulated background speech, it was more difficult for them to learn the new words. Bradlow, Kraus, and Hayes (2003) found that children with learning disabilities have an increased difficulty with understanding sentences in noise than children

without a language disability. The researchers conclude that whilst it is important to present novel words in quieter contexts, it is also important for children to learn to contend with background noise that is pervasive in the school environment. Therefore, apps that allow for background noise to be turned on or off may be important in assisting children learn language in both quieter contexts and with background noise.

The relationship between oral and written language has been well established and documented in the literature (Nation, Snowling, & Clarke, 2007; Snowling & Hulme, 2011) and thus intervention for oral language difficulties often includes literacy and written language. Hutchison et al. (2012) have noted that using iPads for literacy instruction supported student learning. Respondents' incorporation of text into therapy activities suggests that they value the ability to incorporate literacy instruction into language learning activities, but it is necessary to support and scaffold the integration of literacy by having the ability to turn on/off text features.

The findings also reflect that respondents value the additional features that can be obtained in an app and the majority indicated that they would be willing to pay an additional sum if the app contained these features. Whether this would translate to actual sales in a difficult economic climate is unknown.

The evaluation of apps for educational purposes has proved to be challenging because of the sheer number of apps, the variability in terms of content and design features, and lack of agreement in terms of how to evaluate them. The findings from this study show that many SLPs are using apps as a tool for language therapy and are adapting them for clinical functionality. Respondents have also noted that certain features are beneficial when using apps for language intervention.

The findings of this study show that when using apps for language intervention, respondents are incorporating principles of language intervention. However, in order to use this tool more effectively, more nuanced considerations should be made regarding the features of multimedia learning. Additionally, in considering the treatment theory related to the underlying impairments, the active ingredients and the mechanisms of action that effect change on the target may be identified (Turkstra et al., 2016). This may contribute to the development EBP when using apps for language intervention with children.

5.7 The Feature-Matching Checklist

The findings of this study showed that SLPs consider a number of features of apps as important and beneficial for speech-language intervention with children. These findings were considered together with the supporting literature base. The feature-matching checklist presented in Table 3 can offer SLPs an instrument that could facilitate the identification of these features in the app, and enable them to be more discerning when selecting an app for intervention.

Table 3.

Feature Matching Checklist for Apps for speech-language intervention

Feature	Description	Yes	No
Theme	Child Friendly Theme with familiar characters		
Screen	Clean interface no additional pictures/words on screen		
	Some additional pictures/words on the screen		
	Many additional pictures/words on the screen		
	Ability to remove screen elements		
Interactivity	Allows for interactivity with images on screen		
	Some interactivity with images on screen		
	Touch/drag with images on screen		
Images	Animation		
	Photographs		
	Colour illustration		
	Video		
Developmental Levels	More than 3 levels		
	2 – 3 levels		
	Only 1 level		
Examples per Level	More than 20 examples		
	11 – 20 examples		
	Less than 10 examples		
Activity selection	Allows user to select specific activity or items		
Repetition	Target can be repeated		
Pace	Items can be skipped within the app		
	App can be paused at any stage		
Record Feature	Available		
Error Response	Immediate		
	Option to try again		
	Visual display e.g. cross or tick		
	Sound reflects incorrect response		
	Reduce level of difficulty		
	Corrective audio feedback		
Voice	Child voice		
	Adult voice		
	Accent choice		
Reward	Choice of games		
	One game		
	Star chart/token reward		
Customisation	User Profiles		
	Text on/off		
	Background noise on/off		
	Sounds on/off		
	Error response can be adjusted		
Data	Save Progress		
	Report generation		
Content	Description refers to EBP in the development of content & techniques		
	Description refers to EBP in development		
	No reference to EBP		

Chapter 6: Conclusion

6.1 Overview of the Study

This study examined the features of iPad apps by speech-language pathologists for language intervention with children. Since EBP is the gold standard of any intervention, this study was evaluated in terms of incorporating EBP into treatment when using apps. Turkstra et al.'s (2016) Rehabilitation Treatment Taxonomy (RTT) was used as a framework in which to consider EBP. The RTT facilitates the integration of practice-based evidence and EBP by encouraging clinicians to consider the underlying theory, treatment ingredients and mechanisms that result in change in the target. In doing so, the active ingredients of treatment can be identified. This framework together with an understanding of the cognitive basis of multimedia learning, and language intervention principles may facilitate more effective use of language apps for language intervention and contribute to EBP in clinical practice.

This study appears to be the first study to examine the features of apps used in language intervention. As such, it provides valuable insights into the burgeoning use of technology for language intervention by SLPs.

The results of the study identified a number of features of language apps that facilitated or impeded intervention. These features were evaluated in terms of principles of multimedia learning and language intervention principles. From this information, a feature-matching checklist was devised to assist SLPs in selecting apps.

The findings showed that SLPs are using apps to supplement traditional intervention approaches. However they are selecting apps unsystematically without consideration of the features of apps that support and/or facilitate intervention. The portability of the iPad enables SLPs to have a wide variety of resources to address intervention goals, and they are being

used for their convenience rather than their clinical applicability. Apps are motivating and engaging for children and both specific language intervention apps as well as game-based apps are being used.

Social and pragmatic aspects of communication are an important part of intervention, and the findings reflected that SLPs are taking this into consideration when employing the use of apps for intervention. In acknowledging the importance of the social and pragmatic aspects of communication as well as the importance of conversation when using mobile technology, a revised model of Crompton's theory of mobile learning was proposed.

6.2 Implications for Clinical Practice

Although the use of technology for learning is growing faster than we can assess it, the evaluation and implications of using this tool for language intervention are not being systematically considered in clinical practice. In order to justify the use of technology for language intervention, SLPs need to bridge the theory-practice gap. Whilst the reality of any therapeutic intervention is not always transparent with clear boundaries, as clinicians, we need to adopt a broader perspective regarding the theories underlying language learning and intervention if we are to incorporate multimedia learning into intervention. Therefore, when using apps for speech-language intervention SLPs should consider theory and practice related to learning, and multimedia learning to identify how learning is taking place and the specific ingredients that are being used for intervention.

By virtue of the interactive manner that SLPs use apps for intervention, existing rubrics or frameworks cannot simply be adapted for evaluation or classification of apps. Rather, the ability to select apps based on features will allow SLPs to become more discerning in their selection of apps. This, in turn, will promote more robust clinical

information in terms of the features that support language intervention and facilitate much needed research in the field. Additionally, by considering the features of apps, there may be more uniformity and consistency when evaluating apps.

SLPs are uniquely positioned to understand the importance of incorporating all aspects of communication when using mobile learning. Although screen-time guidelines have been revised by the AAP, it is important that SLPs utilize and disseminate their understanding of language and communication to educate others on using digital media so that all aspects of communication are considered.

6.3 Theoretical Implications

In the absence of an evidence base when using apps, SLPs need to use their clinical judgement to incorporate the effective use of apps into practice. Clinical experience can contribute to the formulation of theoretically well-founded interventions (Ebbels, 2017). Karthikeyan and Pais (2010) emphasise that clinical judgement is not about a "slavish adherence to external evidence" (p. 623) but rather the ability to comprehend the nature and strength of evidence and apply it appropriately. In adopting a theory driven approach as a basis for specifying the details of treatment (Turkstra, et al., 2016), SLPs will be able to build a database of evidence that is reflective of current clinical practice. Use of the RTT could foster a deeper understanding of why and how the treatment is supposed to work and facilitate the identification of the active ingredients of treatment.

The efficacy of language intervention is undeniable (Ebbels, 2014; Ebbels et al., 2016; Eisenberg, 2013) but the evidence for effective language intervention strategies for children with language disorders is opaque (Tosh, Arnett, & Scarinci, 2016). This is because many studies fail to identify the specific techniques used to address the targets and this results

in difficulty replicating studies. The identification of the active ingredients of treatment will contribute to vital clinical evidence to support treatment outcomes and enable studies to be replicated.

6.4 Implications for Research

This appears to be the first study on the use of apps for language intervention and it therefore opens the door to a myriad of research possibilities.

The RTT model had not been published at the onset of this study. Thus, although results of the current study suggest that participants are not engaging with the underlying theory when using apps, future research that specifically taps into the use of this model when using apps may provide valuable insight into the ingredients and mechanisms of action when using apps for speech-language pathology.

The usability of the feature-matching checklist is a priority in order to evaluate ease of use, and the ability to facilitate the selection of apps based on features. More discerning selection of apps by SLPs is likely to encourage more efficient and judicious use of apps. In turn, this will allow further research on how specific features of apps contribute to language intervention. In addition, further research is needed to understand the effects of app features on different language goals in various populations.

Co-morbid conditions such as autism, syndromes, and brain injury, among others that may have resulted in a language disorder were not specified. The heterogeneity and complexity of language contributes to difficulty classifying language disorders (Bishop et al., 2016). However, specific features of language may reflect co-morbid conditions. A specific rehabilitation treatment model that specifies the details of treatment more precisely could enable SLPs to draw more accurate conclusions regarding the nature of treatment for specific

types of language disorders.

The use of apps for home practice has proved successful in people with aphasia (Choi, Park, & Paik, 2016; Kurland, Wilson & Stokes, 2014; Stark & Warburton, 2016). Further research on using apps, as a supplement for language intervention may be beneficial and facilitate generalisation of skills addressed in therapy. In addition the use of apps could enable intervention for more children with language disorders.

Highlighting the features of apps identified in this study to app developers may result in improvements in app design and content and contribute to the development of an evidence-base for app use.

The survey participants were recruited based on their own perception of app use and consequently there may have been some sample bias. Future research should account for this by examining participants' knowledge of apps in greater depth.

6.6 Concluding Comments

This study has shown that apps have the potential for providing significant support for speech-language intervention with children. However, in the absence of research, and the pressing need to incorporate EBP into clinical practice, the features of technology, multimedia learning and the features of the device itself must be carefully considered; particularly in relation to children who have language disorders.

Although the discussion presented may be seen as critical, the findings showed that the respondents were in fact, very intuitive regarding the features of apps that facilitated effective intervention and used their clinical knowledge of language intervention and learning when using multimedia. The deficits that emerged from the findings are reflected in the respondents' difficulty integrating practice-based evidence and EBP.

Ultimately, in order to advance the use of EBP in clinical practice, clinicians need to gather practice-based evidence by understanding how a treatment is supposed to work based on the underlying theory so that the active ingredients of treatment can be specified (Lof, 2011; Turkstra, 2016). This study provides a framework that can assist SLPs in identifying the specific ingredients used in treatment. In doing so, this study, calls for SLPs to engage in research around apps and app use so that practice-based evidence and EBP can be integrated.

References

AAP Council on Communications and Media. (2016) Media and Young Minds. *Pediatrics. 138*(5), 1–6 e20162591 doi: 10.1542/peds.2016–2591

Acevedo-Piedra, N. G., Moya-Hoyo, N., ReyRiveiro, M., Gil, S., Sempere, L., Martínez, J., ... & de-Madaria, E. (2014). Validation of the determinant-based classification and revision of the Atlanta classification systems for acute pancreatitis. *Clinical Gastroenterology and Hepatology*, *12*(2), 311–316. doi: 10.1016/j.cgh.2013.07.042

Achmadi, D., Kagohara, D. M., van der Meer, L., O'Reilly, M. F., Lancioni, G. E., Sutherland, D., & Sigafoos, J. (2012). Teaching advanced operation of an iPod-based speech-generating device to two students with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *6*(4), 1258–1264. doi: 10.1016/j.rasd.2012.05.005

Adamson, L. B., Bakeman, R., Deckner, D. F., & Romski, M. (2009). Joint engagement and the emergence of language in children with autism and Down syndrome. *Journal of autism and developmental disorders*, *39*(1), 84–96. doi: 10.1007/s10803-008-0601-7

Agius, M. M., & Vance, M. (2015). A Comparison of PECS and iPad to Teach Requesting to Pre-schoolers with Autistic Spectrum Disorders. *Augmentative and Alternative Communication*, 1–11. doi: 10.3109/07434618.2015.1108363

Airasian, P. W., & Russell, M. K. (2008). *Classroom Assessment: Concepts and Applications* (6th ed.). New York: McGraw-Hill.

Alt, M., Meyers, C., & Ancharski, A. (2012). Using principles of learning to inform language therapy design for children with specific language impairment. *International Journal of Language & Communication Disorders*, *47*(5), 487–498. doi: 10.1111/j.1460-6984.2012.00169.x

Anderson, T. (2004). Toward a theory of online learning. In T. Anderson & F. Elloumni (Eds.), *Theory and practice of online learning* (33–60). Athabasca, AB: Athabasca University Press. Retrieved from http://cde.athabascau.ca/online_book/ch2.html

American Speech-Language-Hearing Association. (2005). *Evidence-based practice in communication disorders* [Position Statement]. Retrieved from http://www.asha.org/Research/EBP/

Atkinson, R. K., Mayer, R. E., & Merrill, M. M. (2005). Fostering social agency in multimedia learning: Examining the impact of an animated agent's voice. *Contemporary Educational Psychology*, *30*(1), 117–139. doi: 10.1016/j.cedpsych.2004.07.001

Ayres, P. (2015). State-of-the-Art research into multimedia learning: A commentary on Mayer's Handbook of Multimedia Learning. *Applied Cognitive Psychology*, *29*(4), 631–636. doi: 10.1002/acp.3142

Baddeley, A. (1997). *Human memory: Theory and Practice (Rev. ed.*). Hove, UK: Psychology Press.

Baddeley, A. (2003). Working memory and language: an overview. *Journal of Communication Disorders*, *36*, 189–208. doi: 10.1016/S0021-9924(03)00019-4

Baltar, F., & Brunet, I. (2012). Social research 2.0: Virtual snowball sampling method using Facebook. *Internet Research*, *22*(1), 57–74. doi: 10.1108/10662241211199960

Barkham, M., & Mellor-Clark, J. (2003). Bridging evidence-based practice and practice-based evidence: Developing a rigorous and relevant knowledge for the psychological therapies. *Clinical Psychology & Psychotherapy*, *10*(6), 319–327. doi: 10.1002/cpp.379

Barr, R. (2013). Memory constraints on infant learning from picture books, television, and touch- screens. *Child Development Perspectives, 7*(4), 205–210. doi:10.1111/cdep.12041.

Beckmann, E. A. **(**2010). Learners on the move: mobile modalities in development studies. *Distance Education, 31*(2), 159–173*.* doi: 10.1080/01587919.2010.498081

Berk, L., & Winsler, A. (1995). *Scaffolding Children's Learning: Vygotsky and Early Childhood Learning*, Washington: National Association for the Education of Young Children.

Berkeley, S., Bender, W. N., Peaster, L. G., & Saunders, L. (2009). Implementation of response to intervention a snapshot of progress. *Journal of Learning Disabilities*, *42*(1), 85–95. doi: 10.1177/0022219408326214

Bétrancourt, M., & Berney, S. (2012). Animation and Learning. In N.M. Seel, (Ed.), *Encyclopedia of the Sciences of Learning* (pp. 252–254). New York: Springer.

Bishop, D. V. M., Snowling, M. J., Thompson, P. A., Greenhalgh, T., & The CATALISE Consortium. (2016). CATALISE: a multinational and multidisciplinary Delphi consensus study. Identifying language impairments in children. *PeerJPreprints* 4:e1986v1. doi: 10.7287/peerj.preprins.1986v1

Bjork, R. (2011). On the symbiosis of remembering, forgetting, and learning. In A. S. Benjamin (Ed.), *Successful Remembering and Successful Forgetting: A Festschrift in Honor of Robert A. Bjork* (pp. 1–22). London, England: Psychology Press.

Bloom, L., & Lahey, M. (1978). Language development and language disorders. New York, John Wiley & Sons.

Bloom, L., & Tinker, E. (2001). The intentionality model and language acquisition. *Monographs of the Society for Research in Child Development, 66*(4), 1–91 doi: 10.1111/1540-5834.00162

Boone, R., & Higgins, K. (2007). The role of instructional design in assistive technology research and development. *Reading Research Quarterly*, *42*(1), 135–140. doi: 10.1598/RRQ.42.1.5

Boyd, D. (2009). ‘‘A Response to Christine Hine.’’ In A. Markham and N. Baym (Eds.), *Internet Inquiry: Conversations about Method*, (pp.26–32). Thousand Oaks, CA: SAGE Publications.

Boynton, P. M., & Greenhalgh, T. (2004). Selecting, designing, and developing your questionnaire. *Bmj*, *328*(7451), 1312–1315. doi:10.1136/bmj.328.7451.1312

Brackenbury, T., Burroughs, E., & Hewitt, L. (2008). A qualitative examination of current guidelines for evidence-based practice in child language intervention. *Language Speech and Hearing Services in Schools*, *39*(1), 78–88. doi: 10.1044/0161-1461(2008/008)

Bradlow, A. R., Kraus, N., & Hayes, E. (2003). Speaking clearly for children with learning disabilities: Sentence perception in noise. *Journal of Speech, Language, and Hearing Research, 46*, 80–97. doi: 10.1121/1.4743692

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind experience and school.* Retrieved March, 2016, from the National Academy of Sciences Web site: http:// www.nap.edu/html/howpeople1

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. doi: 10.1191/1478088706qp063oa

Buabeng-Andoh, C. (2012). Factors influencing teachers' adoption and integration of information and communication technology into teaching: A review of the

literature. *International Journal of Education and Development using Information and Communication Technology*, *8*(1), 136–155, Retrieved from http://files.eric.ed.gov/fulltext/EJ1084227.pdf

Buchanan, E. A., & Hvizdak, E. E. (2009). Online survey tools: Ethical and methodological concerns of human research ethics committees. *Journal of Empirical Research on Human Research Ethics*, *4*(2), 37–48. doi: 10.1525/jer.2009.4.2.37

Buckler, T., & Peterson, M. (2012). Is there an app for that? Developing an evaluation rubric for apps for use with adults with special needs. Retrieved from *The Journal of BSN Honors Research*. *5*(1). archie.kumc.edu/handle/2271/1092.

Bush, L. & Hall, J. (2012). iRead and iLearn: Utilizing iOS Applications in Children's Literature. In P. Resta (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2012* (pp. 2731–2733). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE). Retrieved from https://www.learntechlib.org/p/39999.

Cafiero, J. M. (2012). Technology supports for individuals with autism spectrum disorders. *Journal of Special Education Technology*, *27*(1), 64–76. doi: 10.1177/016264341202700106

Camarata, S. M., Nelson, K. E., & Camarata, M. N. (1994). Comparison of conversational-recasting and imitative procedures for training grammatical structures in children with specific language impairment. *Journal of Speech, Language, and Hearing Research, 37(*6), 1414–1423. doi: 101044/jshr.3706.1414

Cameron, J., Banko, K. M., & Pierce, W. D. (2001). Pervasive negative effects of rewards on intrinsic motivation: The myth continues. *The Behavior Analyst*, *24*(1) 1–44. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2731358/

Cardon, T. A. (2012). Teaching caregivers to implement video modeling imitation training via iPad for their children with autism. *Research in Autism Spectrum Disorders*, *6*(4), 1389–1400. doi: 10.1016/j.rasd.2012.06.002

Caty, M. È., Kinsella, E. A., & Doyle, P. C. (2016). Reflective Practice in Speech-Language Pathology: Relevance for Practice and Education. *Canadian Journal of Speech-Language Pathology & Audiology*, *40*(1) 81–91.

Charter, R. A. (1999). Sample size requirements for precise estimates of reliability, generalizability, and validity coefficients. *Journal of Clinical and Experimental Neuropsychology*, *21*(4), 559-566. doi: 10.1076/jcen.21.4.559.889

Cherner, T., Dix, J., & Lee, C. (2014). Cleaning up that mess: A framework for classifying educational apps. *Contemporary Issues in Technology and Teacher Education*, 14(2), 158–193. Retrieved from file:///Users/demo/Downloads/article_129859%20(1).pdf

Choi, Y. H., Park, H. K., & Paik, N. J. (2016). A Telerehabilitation Approach for Chronic Aphasia Following Stroke. *Telemedicine and e-Health*, *22*(5), 434–440. doi:10.1089/tmj.2015.0138.

Chou, C. C., Block, L., & Jesness, R. (2012). A Case Study of Mobile Learning Pilot Project in K-12 Schools. *Journal of Educational Technology Development & Exchange*, *5*(2). Retrieved from http://sicet.org/web/journals/jetde/jetde12-2/2-Chou.pdf

Christakis, D.A. (2014). Interactive media use at younger than the age of 2 years: time to rethink the American Academy of Pediatrics guideline? *JAMA pediatrics*, *168*(5), 399–400. doi: 10.1001/jamapediatrics.2013.5081

Christensen, R., & Knezek, G. (2008). Self-report measures and findings for information technology attitudes and competencies. In J. Voogt & G. Knezek (Eds.), *International handbook of information technology in primary and secondary education* (pp. 349–

365). New York: Springer.

Cirrin, F. M., & Gillam, R. B. (2008). Language intervention practices for school-age children with spoken language disorders: A systematic review. *Language, Speech, and Hearing Services in Schools, 39*(1), 110–137. doi:10.1044/0161-1461(2008/012)

Clark, M. L., Austin, D. W., & Craike, M. J. (2015). Professional and parental attitudes toward iPad application use in Autism Spectrum Disorder. *Focus on Autism and Other Developmental Disabilities, 30*(3), 174–181. doi: 10.1177/1088357614537353

Clark, R. E. (1983). Reconsidering research on learning from media. *Review of Educational Research*, 53(4), 445–459. doi: 10.3102/0034654305300444

Clark, R. E. (1994). Media Will Never Influence Learning, *Educational Technology Research and Development, 42*(2) 21–29. doi:10.1007/BF02299088

Clark, R.E. & Feldon, D.F. (2005). Five Common but Questionable Principles of Multimedia Learning. In R.E. Mayer (Ed.), (pp. 97 –116). *The Cambridge handbook of Multimedia Learning*. Cambridge: University Press

Clark. W., & Luckin, R. (2013). iPads in the classrooms. London Knowledge Lab Retrieved from https://digitalteachingandlearning.files.wordpress.com/2013/03/ipads-in-the-classroom-report-lkl.pdf

Cleave, P.L & Fey, M.E (1997). Two approaches to the facilitation of grammar in children with language impairments. Rationale and description. *American Journal of Speech-Language Pathology*. *6*(1), 22–32. doi:10.1044/1058-0360.0601.22

Cleave, P. L., Becker, S. D., Curran, M. K., Van Horne, A. J. O., & Fey, M. E. (2015). The Efficacy of Recasts in Language Intervention: A Systematic Review and Meta-analysis. *American Journal of Speech-Language Pathology*. *24*(2): 237–255. doi:10.1044/2015_AJSLP-14-0105.

Cole, K. N., Dale, P. S., & Mills, P. E. (1991). Individual differences in language delayed children's responses to direct and interactive preschool instruction. *Topics in Early Childhood Special Education, 11*(1), 99–124. doi:10.1177/027112149101100110

Cordier, R., Munro, N., Wilkes- Gillan, S., Ling, L., Docking, K., & Pearce, W. (2016). Evaluating the pragmatic language skills of children with ADHD and typically developing playmates following a pilot parent- delivered play- based intervention. *Australian Occupational Therapy Journal*. doi: 10.1111/1440-1630.12299

Couper, L., van der Meer, L., Schäfer, M. C., McKenzie, E., McLay, L., O'Reilly, M. F., ... & Sutherland, D. (2014). Comparing acquisition of and preference for manual signs, picture exchange, and speech-generating devices in nine children with autism spectrum disorder. *Developmental Neurorehabilitation*, *17*(2), 99–109. doi: 10.3109/17518423.2013.870244 PMID:24392652

Courtright, J.A . Courtright, I. C., (1979) Imitative Modeling as a language intervention strategy: The Effects of Two Mediating Variables. *Journal of Speech, Language, and Hearing Research, 22*, 389–402. doi:10.1044/jshr.2202.389

Creswell, J. W. (2014). (Fourth edition) *Research design: Qualitative, Quantitative, and Mixed Methods approaches*. California: Sage publications.

Creswell, J. W., & Plano Clark, V. L. (2011) (2nd edition) *Designing and Conducting Mixed Methods Research.* California: Sage publications

Crichton, S., Peglar, K & White, D. (2012). Personal devices in public settings: Lessons learned from an iPod Touch/iPad project. *The Electronic Journal of e-Learning*, *10,* 23–31. Retrieved from file:///Users/demo/Downloads/ejel-volume10-issue1-article176.pdf

Crompton, H. (2015). A Theory of Mobile Learning. In B.H. Khan, & M. Ally, M. (Eds.), *International Handbook of E-Learning Volume 1: Theoretical Perspectives and Research* (pp. 309 –318). New York: Routledge.

Cubelic, C. C., & Larwin, K. H. (2014). The use of iPad technology in the Kindergarten classroom: A quasiexperimental investigation of the impact on early literacy skills. *Comprehensive Journal of Educational Research, 2*(4), 47–59. Retrieved from http://www.knowledgebasepublishers.org/all%20pdf%20files/Cathleen%20and%20Karen.pdf

Cumming, T. M., & Rodríguez, C.D. (2013). Integrating the iPad into language arts instruction for students with disabilities: Engagement and perspectives. *Journal of Special Education Technology, 28*(4), 43–52. doi: 10.1177/016264341302800404

Dada, S., Horn, T., Samuels, A., & Schlosser, R. W. (2016). Children's attitudes toward interaction with an unfamiliar peer with complex communication needs: comparing high-and low-technology devices. *Augmentative and Alternative Communication, 32*(4) 305–311. doi: 10.1080/07434618.2016.1216597

Danaher, P., Gururajan, R., & Hafeez-Baig, A. (2009). Transforming the practice of mobile learning: promoting pedagogical innovation through educational principles and strategies that work. In: Innovative mobile learning: techniques and technologies. Information Science Reference (IGI Global), Hershey PA, USA, pp. 21-46. Retrieved from https://eprints.usq.edu.au/4714/

Daniel, W.W., (1999). Biostatistics: A Foundation for Analysis in the Health Sciences. 7th Edition. New York: John Wiley & Sons.

DeCurtis, L. L., & Ferrer, D. (2011). Toddlers and technology: Teaching the techniques. *The ASHA Leader*. *16*(11). doi: 10.1044/leader.FTR5.16112011.np

Des Roches, C. A., Balachandran, I., Ascenso, E. M., Tripodis, Y., & Kiran, S. (2014). Effectiveness of an impairment-based individualized rehabilitation program using an iPad-based software platform. *Frontiers in Human Neuroscience*, *8*. doi: 10.3389/fnhum.2014.01015

Diemer, T. T., Fernandez, E., & Streepey, J. W. (2013). Student perceptions of classroom engagement and learning using iPads. *Journal of Teaching and Learning with Technology*, *1*(2), 13–25. Retrieved from http://learn.coc.edu.au/wp-content/uploads/2014/05/3084-10092-1-PB.pdf

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, Phone, Mail, and Mixed-Mode surveys: The Tailored Design Method*. New Jersey, John Wiley & Sons.

Driscoll, M. (2000). Psychology of Learning for Instruction. MA: Allyn & Bacon.

Duckworth, E. (1979). Either We're Too Early and They Can't Learn It or We're Too Late and They Know It Already: The Dilemma of" Applying Piaget". *Harvard Educational Review*, *49*(3), 297–312. doi: 10.17763/haer.49.3.x52266332hg68v02

Durkin, K., & Conti-Ramsden, G. (2014). Turn off or tune in? What advice can SLTs, educational psychologists and teachers provide about uses of new media and children with language impairments? *Child Language Teaching and Therapy*, *30*(2), 187–205. doi: 10.1177/0265659013511471

Ebbels, S. (2014). Effectiveness of intervention for grammar in school-aged children with primary language impairments: A review of the evidence. *Child Language Teaching and Therapy*, 30(1), 7–40. doi: 10.1177/0265659013512321

Ebbels, S. H., Wright, L., Brockbank, S., Godfrey, C., Harris, C., Leniston, H., ... & Marić, N. (2016). Effectiveness of 1: 1 speech and language therapy for older children with (developmental) language disorder. *International Journal of Language & Communication Disorders*. doi: 10.1111/1460-6984.12297

Ebbels, S. H. (2017). Intervention research: Appraising study designs, interpreting findings and creating research in clinical practice, *International Journal of Speech- Language Pathology*, Early Online, 1–14. doi: 10.1080/17549507.2016.1276215

Eisenberg, S. L. (2013). Grammar intervention: Content and procedures for facilitating children's language development. *Topics in Language Disorders, 33*(2), 165–178. doi: 10.1097/TLD.0b013e31828ef28e

Erhel, S., & Jamet, E. (2013). Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness. *Computers & Education, 67,* 156–167. doi: 10.10.16/j.compedu2013.02.109

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: a critical relationship. *Computers & Education, 59,* 423–435. doi: 10.1016/j.compedu.2012.02.001

Fadel, C., & Lemke, C. (2008). Multimodal Learning Through Media: What the Research Says. Retrieved March 2016 from http://www.cisco.com/c/dam/en_us/solutions/industries/docs/education/Multimodal-Learning-Through-Media.pdf

Falloon, G. (2013). Young students using iPads: App design and content influences on their learning pathways. *Computers & Education, 68,* 505–521. doi: 10.1016/j.compedu.2013.06.006

Fernandes, B. (2011). iTherapy: The revolution of mobile devices within the field of speech therapy. *SIG 16 Perspectives on School-Based Issues, 12*(2), 35–40. doi: 10.1044/sbi12.2.35

Fey, M. E., Cleave, P. L., Long, S. H., & Hughes, D. L. (1993). Two Approaches to the Facilitation of Grammar in Children With Language Impairment. An Experimental

Evaluation. *Journal of Speech, Language, and Hearing Research*, *36*(1), 141–157. doi: 10.1044/jshr.3601.141

Fey, M. E., Long, S. H., & Finestack, L. H. (2003). Ten principles of grammar facilitation for children with specific language impairments. *American Journal of Speech-Language Pathology*, *12*, 3–15. doi: 10.1044/1058-0360(2003/048)

Filsecker, M., & Hickey, D. T. (2014). A multilevel analysis of the effects of external rewards on elementary students' motivation, engagement and learning in an educational game. *Computers & Education, 75,* 136-148. doi: 10.1016/j.compedu.2014.02.008

Fisher, K. R., Hirsh-Pasek, K., Newcombe, N., & Golinkoff, R. M. (2013). Taking shape: Supporting preschoolers' acquisition of geometric knowledge through guided play. *Child Development, 84,* 1872–1878. doi: 10.1111/cdev.12091

Fletcher-Watson, S., Pain, H., Hammond, S., Humphry, A., & McConachie, H. (2016). Designing for young children with autism spectrum disorder: A case study of an iPad app. *International Journal of Child-Computer Interaction, 7,* 1– 14. doi: 10.1016/j.ijcci.2016.03.002

Flores, M., Musgrove, K., Renner, S., Hinton, V., Strozier, S., Franklin, S., & Hil, D. (2012). A comparison of communication using the Apple iPad and a picture-based system. *Augmentative and Alternative Communication*, *28*(2), 74–84. doi: 10.3109/07434618.2011.644579

Folkins, J. W., Brackenbury, T., Krause, M., & Haviland, A. (2016). Enhancing the therapy experience using principles of video game design. *American Journal of Speech-Language Pathology*, *25*(1), 111–121. doi: 10.1044/2015_AJSLP-14-0059

Frymark, T., Venediktov, R., & Wang, B. (2010). Effectiveness of interventions for preschool children with fluency disorders: A comparison of direct versus indirect treatments. ASHA's National Center for Evidence-Based Practice in Communication Disorders. Retrieved from http://www.asha.org/uploadedFiles/EBSRFluencyDisorders.pdf

Ganz, J. B., Hong, E. R., & Goodwyn, F. D. (2013). Effectiveness of the PECS Phase III app and choice between the app and traditional PECS among preschoolers with ASD. *Research in Autism Spectrum Disorders*, *7*(8), 973–983. doi: 10.1016/j.rasd.2013.04.003

Gee, J.P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment (CIE)*, *1*(1), 1–4. doi: 10.1145/950566.950595

Gerber, S., & Wankoff, L. (2010). Historical and contemporary views of nature-nurture debate: A continuum of perspectives for the speech-language pathologist. *Language Development: Foundations, processes, and clinical applications*, 5593. Retrieved from https://www.homeworkmarket.com/sites/default/files/q1/25/01/ps345-chapter03_0.pdf

Gillam, S. L., & Gillam, R. B. (2006). Making evidence-based decisions about child language intervention in schools. *Language, Speech, and Hearing Services in Schools*, *37*(4), 304–315. doi: 10.1044/0161-1461(2006/035)

Gillam, R. B., Hoffman, L. M., Marler, J. A., & Wynn-Dancy, M. L. (2002). Sensitivity to Increased Task Demands: Contributions from Data- Driven and Conceptually Driven Information Processing Deficits. *Topics in Language Disorders*, *22*(3), 30–48. Retrieved from https://www.andrews.edu/~rbailey/Chapter%20Ten/6675069.pdf

Gillham, B. (2008). *Developing a questionnaire*. London, A&C Black.

Girolametto, L., Pearce, P. S., & Weitzman, E. (1996). Interactive focused stimulation for toddlers with expressive vocabulary delays. *Journal of Speech, Language, and Hearing Research*, *39*(6), 1274–1283. doi: 10.1044/jshr.3906.1274

Godwin-Jones, R. (2011). Mobile apps for language learning. *Language Learning & Technology,* 15(2), 2–11. Retrieved from http://llt.msu.edu/issues/june2011/emerging.pdf

Goldbart, J., Chadwick, D., & Buell, S. (2014). Speech and language therapists' approaches to communication intervention with children and adults with profound and multiple learning disability. *International Journal of Language & Communication Disorders*, *49*(6), 687–701. doi: 10.1111/1460-6984.12098

Gonzalez, M. (2014). App Evaluation: UDL Tool 1.0. In M. Searson & M. Ochoa (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference 2014 (pp. 1809–1811). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE). Retrieved February 7, 2015 from http://www.editlib.org/p/131040

Gonzalez, M. & Fryer, C. (2013). The effect of the iPad on the readiness skills of at-risk preschoolers. In R. McBride & M. Searson (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 2013* (pp. 4380–4383). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Good, J., Lance, D., & Rainey, J., (2014) The effects of Morphological Awareness Training on Reading, Spelling and Vocabulary Skills. *Communication Disorders Quarterly*, *36*(3), 142–151. doi: 10.1177/1525740114548917

Gosnell, J., Costello, J., & Shane, H. (2011). Using a clinical approach to answer "What communication apps should we use?" *SIG 12 Perspectives on Augmentative and Alternative Communication, 20*(3), 87–96. doi: 10.1044/aac20.3.87

Green, L. S., Hechter, R. P., Tysinger, P. D., & Chassereau, K. D. (2014). Mobile app selection for 5th through 12th grade science: The development of the MASS rubric. *Computers & Education, 75*, 65–71. doi: 10.1016/j.compedu.2014.02.007

Guernsey, L., (2016). Who's By Their Side? Questions of Context Deepen the Research on Children and Media. In R. Barr, & D.N. Linebarger, (Eds.), *Media Exposure During Infancy and Early Childhood.* (pp. 5–32). Switzerland, Springer International Publishing.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods, 18*(1), 59–82. doi: 10.1177/1525822X05279903

Gunderson, E. A., Gripshover, S. J., Romero, C., Dweck, C. S., Goldin- Meadow, S., & Levine, S. C. (2013). Parent praise to 1- to 3- year- olds predicts children's motivational frameworks 5 years later. *Child Development, 84*(5), 1526–1541. doi: 10.1111/cdev.12064

Haßler, B., Major, L., & Hennessy, S. (2016). Tablet use in schools: a critical review of the evidence for learning outcomes. *Journal of Computer Assisted Learning, 32*(2), 139–156. doi: 10.1111/jcal.12123

Hammond, J., & Gibbons, P. (2001). What is scaffolding? In A. Burns, & H. de Silva Joyce (Eds.), *Teachers' voices: Explicitly supporting reading and writing in the classroom* (pp. 8–16). Sydney, NSW: Macquarie University.

Hamshire, C., & Lachkovic, J. (2016). Developing a Framework for App Evaluation: Empowering Learning and Communication with iPads for Children and Young People with Communication Impairments. In *Communications in Computer and Information Science. International Conference on Well-Being in the Information Society* (pp. 69–81). Switzerland, Springer International Publishing.

Hart, T., Ferraro, M., Myers, R., & Ellis, C. A. (2014a). Opening the black box: lessons learned from an interdisciplinary inquiry into the learning-based contents of brain injury rehabilitation. *Archives of Physical Medicine and Rehabilitation*, *95*(1), S66–S73. doi: 10.1016/j.apmr.2013.03.033

Hart, T., Tsaousides, T., Zanca, J. M., Whyte, J., Packel, A., Ferraro, M., & Dijkers, M. P. (2014b). Toward a theory-driven classification of rehabilitation treatments. *Archives of Physical and Medical Rehabilitation*, *95*(1) S33–S44.e32. doi: 10.1016/j.apmr.2013.05.032

Harte, J., Oliveira, A., Frizelle, P., & Gibbon, F. (2016). Children's comprehension of an unfamiliar speaker accent: a review. *International Journal of Language & Communication Disorders*. 51(3), 221–235. doi: 10.1111/1460-6984.12211

Hennig, N., (2014). Selecting and Evaluating the Best Mobile Apps for Library Services. *Library Technology Reports*, *50*(8), 15–17.

Henninger, A. & Hung-En Sung, H.E. (2012), Mail Survey in Social Research. In L. Gideon, (Ed.), *Handbook of Survey Methodology for the Social Sciences* (pp. 297–312). New York, NY: Springer.

Hewson, C., & Laurent, D. (2012), Research Design and Tools for Internet Research. In J. Hughes, (Ed.), *Sage Internet Research Methods* (pp. 165–194) London, Sage Publications.

Hibberts, M., Burke Johnson, R., & Hudson, K., (2012), Common Survey Sampling Techniques. In L. Gideon, (Ed.), *Handbook of Survey Methodology for the Social Sciences*. (pp. 53–74). New York, NY: Springer.

Hicks, S. C., Rivera, C. J., & Wood, C. L. (2015). Using Direct Instruction: Teaching Preposition Use to Students with an Intellectual Disability. *Language, Speech, and Hearing Services in Schools*. *46*(3), 194–206. doi: 10.1044/2015_LSHSS-14-0088

Hirsh-Pasek, K., Zosh, J. M., Golinkoff, R. M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). Putting Education in "Educational" Apps Lessons From the Science of Learning. *Psychological Science in the Public Interest*, *16*(1), 3–34. doi: 10.1177/1529100615569721

Hoff, E. (2006). How social contexts support and shape language development. *Developmental Review*, *26*(1), 55–88. doi: 10.1016/j.dr.2005.11.002

Hourcade, J. P., Williams, S. R., Miller, E. A., Huebner, K. E., & Liang, L. J. (2013, April). Evaluation of tablet apps to encourage social interaction in children with autism spectrum disorders. In *Proceedings of the SIGCHI Conference on human factors in computing systems* (pp. 3197–3206). ACM. doi: 10.1145/2470654.2466438

Hula, S. N. A., Robin, D. A., Maas, E., Ballard, K. J., & Schmidt, R. A. (2008). Effects of feedback frequency and timing on acquisition, retention, and transfer of speech skills in acquired apraxia of speech. *Journal of Speech, Language, and Hearing Research*, *51*(5), 1088–1113. doi: 10.1044/1092-4388(2008/06-0042)

Hutchison, A., Beschorner, B., & Schmidt- Crawford, D. (2012). Exploring the use of the iPad for literacy learning. *The Reading Teacher*, *66*(1), 15–23. doi: 10.1002/TRTR.01090

Hwang, G.-J., Wu, C.-H., & Kuo, F.-R. (2013). Effects of Touch Technology-based Concept Mapping on Students' Learning Attitudes and Perceptions. *Educational Technology & Society*, *16*(3), 274–285. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.404.2181&rep=rep1&type=pdf

Hynan, A., Murray, J., & Goldbart, J. (2014). 'Happy and excited': Perceptions of using digital technology and social media by young people who use augmentative and alternative communication. *Child Language Teaching and Therapy*, *30*(2), 175–186. doi: 10.1177/0265659013519258

James, N., & Busher, H. (2007). Ethical issues in online educational research: protecting privacy, establishing authenticity in email interviewing. *International Journal of Research & Method in Education*, *30*(1), 101–113. doi: 10.1080/1743727070120786

Janghorban, R., Roudsari, R. L., & Taghipour, A. (2014). Skype interviewing: The new generation of online synchronous interview in qualitative research. *International Journal of Qualitative Studies on Health and Well-being*, *9*. doi: 10.3402/qhw.v9.24152

Johnson, C. I., & Priest, H. A. (2014). The Feedback Principle in Multimedia Learning. In R.E. Mayer, (Ed.) *The Cambridge Handbook of Multimedia Learning*. (pp. 449–463) New York, NY: Cambridge University Press.

Johnson, C. I., Priest-Walker, H. A., Durlach, P. J., & Serge, S. R. (2012). The Effect of Feedback Specificity in a Virtual Training Environment. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting 56*(1), (pp. 1576–580). SAGE Publications.

Johnson, T. P., & Wislar, J. S. (2012). Response rates and nonresponse errors in surveys. *JAMA*, 307(17), 1805–1806. doi: 10.1001/jama.2012.3532

Jonas-Dwyer, D., Clark, C., Celenza, A., & Siddiqui, Z. (2012). Evaluating apps for learning and teaching. *International Journal of Emerging Technologies in Learning (iJET), 7*(1), 54–57. Retrieved from http://www.academia.edu/download/40943392/Evaluating_Apps_for_learning_and_Teaching.pdf

Joy, E. H., & Garcia, F. E. (2000). Measuring learning effectiveness: A new look at no-significant-difference findings. *Journal of Asynchronous Learning Networks, 4*(1), 33–39. Retrieved from http://en.wikieducator.org/images/1/1f/ALN_Measuring_Learning_Effectiveness.pdf

Juel, C. (1996). What makes literacy tutoring effective? *Reading Research Quarterly, 31,* 268–269. doi: 10.1598/RRQ.31.3.3

Justice, L.M. (2010) When craft and science collide: Improving therapeutic practices through evidence-based innovations, *International Journal of Speech-Language Pathology, 12*(2), 79–86, doi: 10.3109/17549500903373984

Kaderavik, J.N. (2011). *Language Disorders in Children: Fundamental Concepts of Assessment and Intervention.* Pearson/Prentice

Kagohara, D. M., Sigafoos, J., Achmadi, D., O'Reilly, M. F., & Lancioni G., (2012) Teaching children with autism spectrum disorders to check the spelling of words. *Research in Autism Spectrum Disorders, 6*(1): 304–310. doi: 10.1016/j.rasd.2011.05.012

Kagohara, D. M., van der Meer, L., Ramdoss, S., O'Reilly, M. F., Lancioni, G. E., Davis, T. N., & Sigafoos, J. (2013). Using iPods® and iPads® in teaching programs for individuals with developmental disabilities: A systematic review. *Research in Developmental Disabilities, 34*(1), 147–156. doi: 10.1177/1534650110379633

Kaiser, A. P., & Roberts, M. Y. (2011). Advances in early communication and language intervention. *Journal of Early Intervention, 33*(4), 298–309. doi: 10.1177/1053815111429968

Kamhi, A. G. (1999). To Use or Not to Use. Factors That Influence the Selection of New Treatment Approaches. *Language, Speech, and Hearing Services in Schools*, *30*(1), 92–98. doi: 10.1044/0161-1461.3001.92

Kamhi, A.G., (2014) Improving Clinical Practices for Children With Language and Learning Disorders *Language, Speech, and Hearing Services in Schools, 45*, 92–103. doi: 10.1044/2014_LSHSS-13-0063

Karsenti, T., & Fievez, A., (2013). The iPad in education: uses, benefits, and challenges. Retrieved from http://karsenti.ca/ipad/pdf/iPad_report_Karsenti-Fievez_EN.pdf

Karthikeyan, G., & Pais, P. (2010). Clinical judgement & evidence-based medicine: time for reconciliation. *The Indian Journal of Medical Research*, *132*(5), 623–626 doi: 10.4103/0971-5916.73418

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in learning technology*, *20*(1), 1–17. doi: 10.3402/rlt.v20i0.14406

Kiernan, B. J., & Snow, D. P. (1999). Bound-morpheme generalization by children with SLI: Is there a functional relationship with accuracy of response to training targets? *Journal of Speech, Language, and Hearing Research*, 42, 649–662. doi: 10.1044/jslhr.4203.649

King, M. L., Takeguchi, K., Barry, S. E., Rehfeldt, R. A., Boyer, V. E., & Mathews, T. L. (2014). Evaluation of the iPad in the acquisition of requesting skills for children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 8*(9), 1107–1120. doi: 10.1016/j.rasd.2014.05.011

King, A. M., Thomeczek, M., Voreis, G., & Scott, V. (2014). iPad® use in children and young adults with Autism Spectrum Disorder: An observational study. *Child Language Teaching and Therapy*, *30*(2), 159–173. doi: 10.1177/0265659013510922

Kirkorian, H. L., Pempek, T. A., Murphy, L. A., Schmidt, M. E., & Anderson, D. R. (2009). The impact of background television on parent–child interaction. *Child development*, *80*(5), 1350–1359. doi: 10.1111/j.1467-8624.2009.01337.x

Kirschner, P. A. (2002). Cognitive load theory: Implications of cognitive load theory on the design of learning. *Learning and Instruction*, *12*(1), 1–10. doi: 10.1016/S0959-4752(01)00014-7

Klingberg, T. (2010). Training and plasticity of working memory. *Trends in Cognitive Sciences, 14*, 317–324. doi: 10.1016/j.tics.2010.05.002

Koole, M. L. (2009) A Model for Framing Mobile Learning. In M. Ally (Ed.), *Mobile learning: Transforming the delivery of education and training*, (pp. 25–47), Athabasca, Canada, Athabasca University Press,

Kozinets, R. V. (2002). The field behind the screen: Using netnography for marketing research in online communities. *Journal of Marketing Research*, *39*(1), 61–72. doi: 10.1509/jmkr.39.1.61.18935

Kucirkova, N. (2014). iPads in early education: separating assumptions and evidence. *Frontiers in Psychology*, *5*(715) 1–3 doi: 10.3389/fpsyg.2014.00715

Kuhl, P. K. (2007). Is speech learning "gated" by the social brain? *Developmental Science, 10*, 110 –120. doi: 10.1111/j.1467-7687.2007.00572.x

Kühl, T., Eitel, A., Damnik, G., & Körndle, H. (2014). The impact of disfluency, pacing, and students' need for cognition on learning with multimedia. *Computers in Human Behavior*, *35*, 189–198. doi: 10.1016/j.chb.2014.03.004

Kurland, J., Wilkins, A. R., & Stokes, P. (2014). iPractice: Piloting the effectiveness of a tablet-based home practice program in aphasia treatment. *Seminars in Speech and Language*, *35*(1) 051–064. NIH Public Access. doi: 10.1055/s-0033-1362991

Laerd Dissertation (2012) The Online Research Guide for your Dissertation and Thesis Retrieved May, 2015 from http://dissertation.laerd.com/

Lauer, C., McLeod, M., & Blythe, S. (2013). Online survey design and development: A Janus-faced approach. *Written Communication*, *30*(3), 330–357. doi: 10.1177/0741088313488075

Law, J. (1997). Evaluating intervention for language impaired children: A review of the literature. *International Journal of Language & Communication Disorders*, *32*(2s), 1–14. doi: 10.1111/j.1460-6984.1997.tb01621.x

Law, J., Garrett, Z., & Nye, C. (2004). The Efficacy of Treatment for Children With Developmental Speech and Language Delay/Disorder A Meta-Analysis. *Journal of Speech, Language, and Hearing Research*, *47*(4), 924–943. doi:10.1044/1092-4388(2004/069)

Law, J., Roulstone, S., & Lindsay, G. (2015). Integrating external evidence of intervention effectiveness with both practice and the parent perspective: development of 'What Works' for speech, language, and communication needs. *Developmental Medicine & Child Neurology*, *57*(3), 223–228. doi: 10.1111/dmcn.12630

Lee, C. Y., & Cherner, T. S. A Comprehensive Evaluation Rubric for Assessing Instructional Apps. *Journal of Information Technology Education: Research, 14,* 21–53. Retrieved from http://jite.org/documents/Vol14/JITEV14ResearchP021-053Yuan0700.pdf

Lee, A., Lang, R., Davenport, K., Moore, M., Rispoli, M., van der Meer, L., ... & Chung, C. (2013). Comparison of therapist implemented and iPad-assisted interventions for children with autism. *Developmental Neurorehabilitation*, (0), 1–7. doi: 10.109/17518423.2013.830231

Leonard, L. (1998). Children with Specific Language Impairments. Cambridge, MA: MIT Press.

Lepper, M. R., Henderlong, J., & Gingras, I. (1999). Understanding the effects of extrinsic rewards on intrinsic motivation—Uses and abuses of meta-anlysis: Comment on Deci, Koestner, and Ryan (1999). *Psychological Bulletin, 125*(6) 669–679 doi: 10.1037/0033-2909/125.6.669

Lifter, K., Foster-Sanda, S., Arzamarski, C., Briesch, J., & McClure, E. (2011). Overview of play: Its uses and importance in early intervention/early childhood special education. *Infants & Young Children*, *24*(3), 225–245. doi: 10.1097/IYC.0b013e31821e995c

Lincoln, Y., & Guba, E. G. (1985). *Naturalistic Inquiry*. Beverly Hills, CA: Sage.

Lindsay, G., & Strand, S. (2016). Children with language impairment: Prevalence, associated Difficulties, and ethnic Disproportionality in an English Population. *Frontiers in Education, 1*, 1–14. doi: 10.3389/feduc.2016.00002

Lof, G. L. (2011). Science-based practice and the speech-language pathologist. *International Journal of Speech-Language Pathology*, *13*(3), 189–196. doi: 10.3109/17549507.2011.528801

Lorah, E. R., Tincani, M., Dodge, J., Gilroy, S., Hickey, A., & Hantula, D. (2013). Evaluating picture exchange and the iPad™ as a speech generating device to teach communication to young children with autism. *Journal of Developmental and Physical Disabilities*, *25*(6), 637–649. doi: 10.1007/s10882-013-9337-1

Lorah, E. R., Crouser, J., Gilroy, S. P., Tincani, M., & Hantula, D. (2014). Within stimulus prompting to teach symbol discrimination using an iPad® speech generating device. *Journal of Developmental and Physical Disabilities*, *26*(3), 335–346. doi: 10.1007/s10882-014-9369-1

Maddux, C. D. & Johnson, D. L. (2012). External validity and research in information technology in education. *Computers in the Schools, 29*(3), 249–252. doi: 10.1080/07380569.2012.703605

Martín-Monje, E., Arús-Hita, J., Rodríguez-Arancón, P., & Calle-Martínez, C. (2013). REALL: Rubric for the evaluation of apps in language learning. Retrieved from http://eprints.ucm.es/25096/

Massat, C. R., McKay, C., & Moses, H. (2009). Monkeying around: Use of Survey Monkey as a Tool for School Social Work. *School Social Work Journal*, *33*(2), 44 –56.

Massey, S. L. (2013). From the reading rug to the play center: Enhancing vocabulary and comprehensive language skills by connecting storybook reading and guided play. *Early Childhood Education Journal*, *41*(2), 125–131. doi: 10.1007/s10643-012-0524-y

Mayer, R. E. (2002). Multimedia learning. *Psychology of Learning and Motivation*, *41*, 85–139. doi: 10.1016/S0079-7421(02)80005-6

Mayer, R. E. (2003). The promise of multimedia learning: using the same instructional design methods across different media. *Learning and Instruction, 13*, 125–139. doi: 10.1016/S0959-47529(02)00016-6

Mayer, R. (2014). Cognitive theory of multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed.), (pp. 43–71). New York, N.Y: Cambridge University Press.

Mayer, R. E., & Chandler, P. (2001). When learning is just a click away: Does simple user interaction foster deeper understanding of multimedia messages? *Journal of Educational Psychology, 93,* 390–397. doi: 10.1037/0022- 0663.93.2.390

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational psychologist, 38*(1), 43–52. doi: 10.1207/S15326985EP3801_6

Mayer, R. E., Sobko, K., & Mautone, P. D. (2003). Social cues in multimedia learning: Role of speaker's voice. *Journal of Educational Psychology, 95*(2), 419–425. doi: 10.1037/0022-0663.95.2.419

McCurtin, A., & Roddam, H. (2012). Evidence- based practice: SLTs under siege or opportunity for growth? The use and nature of research evidence in the profession. *International Journal of Language & Communication Disorders, 47*(1), 11–26. doi: 10.1111/j.1460-6984.2011.00074.x

McMillan, B., & Saffran, J. R. (2016). Learning in complex environments: the effects of background speech on early word learning. *Child Development, 87*(6), 1841–1855. doi: 10.1111/cdev.12559

McMillan, J. & Schumacher, S. (2001). Research in Education: A Conceptual Introduction. (5th Ed). New York: Addison-Wesley Longman.

McNaughton, D., & Light, J. (2013). The iPad and mobile technology revolution: Benefits and challenges for individuals who require augmentative and alternative communication. *Augmentative and Alternative Communication, 29*(2), 107–116. doi: 10.3109/07434618.2013.784930

Monroe, M. C., & Adams, D. C. (2012). Increasing response rates to web-based surveys. *Journal of Extension, 50*(6), 6–7 Retrieved from https://www.joe.org/joe/2012december/pdf/JOE_v50_6tt7.pdf

Moos, D. C., & Marroquin, E. (2010). Multimedia, hypermedia, and hypertext: motivation considered and reconsidered. *Computers in Human Behavior*, *26*(3), 265–276. doi: 10.1016/j.chb.2009.11.004

Moreno, R., & Mayer, R. E. (2004). Personalized messages that promote science learning in virtual environments. *Journal of Educational Psychology*, *96*(1), 165–173. doi: 10.1037/0022-0663.96.1.165

Morrison, A. B., & Chein, J. M. (2011). Does working memory training work? The promise and challenges of enhancing cognition by training working memory. *Psychonomic Bulletin & Review, 18,* 46–60 doi: 10.3758/s13423-010-0034-0

Muis, K. R., Ranellucci, J., Trevors, G., & Duffy, M. C. (2015). The effects of technology-mediated immediate feedback on kindergarten students' attitudes, emotions, engagement and learning outcomes during literacy skills development. *Learning and Instruction, 38,* 1–13. doi: 10.1016/j.learninstruc.2015.02.001

Murdock, L. C., Ganz, J., & Crittendon, J. (2013). Use of an iPad play story to increase play dialogue of preschoolers with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *43*(9), 2174–2189. doi: 10.1007/s10803-013-1770-6

Murray, O., & Olcese, N. (2011). Teaching and learning with iPads, ready or not? *TechTrends, 55*(6), 42–48. doi: 10.1007/s11528-011-0540-6

Nation, K., Snowling, M.J. & Clarke, P. (2007). Dissecting the relationship between language skills and learning to read: Semantic and phonological contributions to new vocabulary learning in children with poor reading comprehension. *Advances in Speech Language Pathology, 9*(2), 131–139. doi: 10.1080/14417040601145166

Neely, L., Rispoli, M., Camargo, S., Davis, H., Boles, M., (2013). The effect of instructional use of an iPad on challenging behavior and academic engagement for two students with autism. *Research in Autism Spectrum Disorders*, *7*, 509–516. doi: 10.1016/j.rasd.2012.12.004

Newton, D. A., & Dell, A. G. (2011). Mobile devices and students with disabilities: What do best practices tell us? *Journal of Special Education Technology*, *26*(3), 47–49. Retrieved from http://search.proquest.com/openview/069e20c5f77b0c6370b79b91ef94783e/1.pdf?pq-origsite=gscholar&cbl=6091

Newton, C., & Ridgeway, S. (2016). Novel accent perception in typically-developing school-aged children. *Child Language Teaching and Therapy*, *32*(1), 111–123. doi: 10.1177/0265659015578464

Ok, M. W., Kim, M. K., Kang, E. Y., & Bryant, B. R. (2016). How to Find Good Apps: An Evaluation Rubric for Instructional Apps for Teaching Students With Learning Disabilities. *Intervention in School and Clinic*, *51*(4), 244–252. doi: 10.1177/1053451215589179

Oldendick, R. (2012) Survey Research Ethics. In Gideon, L. (Ed). *Handbook of Survey Methodology for the Social Sciences*. *Handbook of Survey Methodology for the Social Sciences*. (pp. 23–35). New York, NY: Springer.

Onwuegbuzie, A. J., & Leech, N. L. (2004). On becoming a pragmatic researcher: the importance of combining quantitative and qualitative research methodologies. *International Journal of Social Research Methodology*, *8*(5), 375–387. doi: 10.1080/13645570500402447

Onwuegbuzie, A. J., & Teddlie, C. (2003). A Framework for Analyzing Data in Mixed Methods Research. In Tashakkori, A. & Teddlie, C. (Eds.), *Handbook on mixed methods in the behavioral and social sciences,* (pp. 351–84). Thousand Oaks, CA: Sage.

Owens, R. E. (2010). *Language development: A functional approach to assessment and intervention.* Boston, Mass: Pearson/Allyn & Bacon.

Paas, F., Renkl, A., & Sweller, J. (2003). Cognitive load theory and instructional design: Recent developments. *Educational psychologist*, *38*(1), 1–4. doi: 10.1207/S15326985EP3801_1

Paas, F., Tuovinen, J. E., & Tabbers, H. (2003). Cognitive Load Measurement as a Means to Advance Cognitive Load Theory. *Educational Psychologist*, *38*(1), 63–71. doi: 10.1207/S15326985EP3801_8

Pachler, N., Bachmair, B., & Cook, J. (2010). Mobile Devices as Resources for Learning: Adoption trends, Characteristics, Constraints and Challenges. In N. Pachler, B. Bachmair & J. Cook (Eds.), *Mobile Learning Mobile Learning: structures, agency, practices.* (pp. 73–93). New York: Springer Science & Business Media.

Paik, E. (2010). Learning with Animation and the Illusion of Understanding. Retrieved from Digital Scholarship dissertations. http://digitalscholarship.unlv.edu/cgi/viewcontent.cgi?article=1677&context=thesesdissertations

Paivio, A. (1991). Dual coding theory: Retrospect and current status. *Canadian Journal of Psychology/Revue Canadienne de Psychologie*, *45*(3), 255–287. doi: 10.1037.h0084295

Parish-Morris, J., Mahajan, N., Hirsh-Pasek, K., Golinkoff, R. M., & Collins, M. F. (2013). Once upon a time: parent–child dialogue and storybook reading in the electronic era. *Mind, Brain, and Education, 7*(3), 200–211. doi: 10.1111/mbe.12028

Park, Y. (2011). A pedagogical framework for mobile learning: Categorizing educational applications of mobile technologies into four types. *The International Review of Research in Open and Distributed Learning*, *12*(2), 78–102. doi: 10.19173/irrodl.v12i2.791

Park, J., Parsons, D., & Ryu, H. (2010). To flow and not to freeze: Applying flow experience to mobile learning. *Transactions on Learning Technologies*, *3*(1), 56–67. doi: 10.1109/TLT.2010.1.

Parker-McGowan, Q., Chen, M., Reichle, J., Pandit, S., Johnson, L., & Kreibich, S. (2014). Describing Treatment Intensity in Milieu Teaching Interventions for Children With Developmental Disabilities: A Review. *Language, Speech, and Hearing services in Schools*, *45*(4), 351–364. doi: 10.1044/2014_LSHSS-13-0087

Parlangeli, O., Marchigiani, E., & Bagnara, S. (1999). Multimedia systems in distance education: effects of usability on learning. *Interacting with Computers*, *12*(1), 37–49. doi: 10.1016/S0953-5438(98)00054-X

Pegrum, M., Howitt, C., & Striepe, M. (2013). Learning to take the tablet: How pre-service teachers use iPads to facilitate their learning. *Australasian Journal of Educational Technology*, *29*(4), 464 –479. doi: 10.14742/ajet.187

Pellerin, M. (2012). Digital documentation: Using digital technologies to promote language assessment for the 21st century. *OLBI Working Papers/Les Cahiers de l'ILOB, 4*, 19–36. Retrieved from https://uottawa.scholarsportal.info/ojs/index.php/ILOB-OLBI/article/viewFile/1105/955

Pellerin, M. (2014). Language Tasks Using Touch Screen and Mobile Technologies: Reconceptualizing Task-Based CALL for Young Language Learners. *Canadian Journal of Learning and Technology*, *40*(1). 1–23. Retrieved from file:///Users/demo/Downloads/article_147442.pdf

Pickering, M., & McAllister, L. (2000). A conceptual framework for linking and guiding domestic cross-cultural and international practice in speech-language pathology. *Advances in Speech Language Pathology*, *2*(2), 93–106. doi:10.3109/14417040008996794

Prensky, M. R. (2010). *Teaching digital natives: Partnering for real learning*. Thousand Oak, California: Corwin Press.

Primavera, J., Wiederlight, P. P., & DiGiacomo, T. M. (2001, August). Technology access for low-income preschoolers: Bridging the digital divide. In *Annual meeting of the American Psychological Association, San Francisco*. Retrieved from http://www.knowledgeadventure.com/jumpstartworld/_docs/ChildTechnology_White_Paper.pdf

Powell, S. (2014). Choosing iPad apps with a purpose: Aligning skills and standards. *Teaching Exceptional Children*, 47 (1), 20 – 26. doi: 10.1177/0040059914542765

Proctor, L. A., & Wang, Y. (2015). Using iPads and Mobile Technology for Children with Developmental Disabilities: Facilitating Language and Literacy Development. In N.R. Silton (Ed.), *Recent Advances in Assistive Technologies to Support Children with Developmental Disorders* (pp. 45–78). Hershey, PA: IGI Global.

Purcell, K., Entner, R., & Henderson, N. (2010). *The rise of apps culture*. Washington, DC: Pew Research Center's Internet and American Life Project. http://pewinternet.org/Reports/2010/The-Rise-of-Apps-Culture.aspx. Accessed 1 March 2015.

Reed, S. K. (2006). Cognitive architectures for multimedia learning. *Educational Psychologist, 41*(2), 87–98. doi: 10.1207/s15326985ep4102_2

Reiser, R. A., & Keglemann, H. W. (1994). Evaluating instructional software: A review and critique of current methods. *Educational Technology Research and Development, 42*(3), 63–69. doi: 10.1007/BF02298095

Rey, G. D., & Steib, N. (2013). The personalization effect in multimedia learning: The influence of dialect. *Computers in Human Behavior, 29*, 2022–2028. doi: 10.1016/j.chb.2013.04.003.

Reyes, D. M. (2014). The Effects of iPad Apps on Student Achievement in Literacy for Children in 2nd and 3rd Grade. Master's Theses and Capstone Projects. Paper 131. Retrieved from: http://scholar.dominican.edu/cgi/viewcontent.cgi?article=1129&context=masters-theses

Richmond, J., & Nelson, C. A. (2007). Accounting for change in declarative memory: A cognitive neuroscience approach. *Developmental Review, 27*, 349–373. doi: 10.1016/j.dr.2007.04.002

Ricks, S. L., & Alt, M. (2016). Theoretical Principles to Guide the Teaching of Adjectives to Children Who Struggle With Word Learning: Synthesis of Experimental and Naturalistic Research With Principles of Learning Theory. *Language, Speech, and Hearing Services in Schools, 47*(3), 181–190. doi: 10.1044/2016_LSHSS-15-0034

Rieber, L. P. (1991). Animation, incidental learning, and continuing motivation. *Journal of Educational Psychology, 83*(3), 318–328. doi: 10.1037/0022-0663.83.3.318

Rivera, C.J., Spooner, F., Wood, C.L., & Hicks, S.C. (2013) Multimedia shared stories for diverse learners with moderate intellectual disability. *Journal of Special Education Technology 28*(4), 53–68. doi: 10.1177/016264341302800405

Rodríguez, C. D., & Cumming, T. M. (2016). Employing Mobile Technology to Improve Language Skills of Young Students with Language-Based Disabilities. *Assistive Technology*, 1–9. doi: 10.1080/10400435.2016.1171810

Rodríguez, C. D., Strnadová, I., & Cumming, T. M. (2015). Implementing iPad and Mobile Technologies for Students with Intellectual Disabilities. In N. R. Silton. (Ed.), *Recent Advances in Assistive Technologies to Support Children with Developmental Disorders*, (pp. 27 – 44) Hershey, PA: IGI Global

Rose, D. H., & Meyer, A. (2002). *Teaching every student in the digital age: Universal design for learning*. Alexandria, VA: Association for Supervision and Curriculum

Roth, F. P., & Worthington, C. K. (2015). *Treatment Resource Manual for Speech Language Pathology*. San Diego: Singular Pub. Group.

Sackett, D. L., Rosenberg, W. M., Gray, J. A., Haynes, R. B., & Richardson, W. S. (1996). Evidence based medicine: what it is and what it isn't. *BMJ: British Medical Journal*, *312*(7023), 71–72. doi: 10.1136/bmj.312.7023.71

Salomon, G. (1979). Interaction of media, cognition and learning. San Francisco: Jossey Bass

Sánchez, J., Salinas, A., Contreras, D., & Meyer, E. (2011). Does the new digital generation of learners exist? A qualitative study. *British Journal of Educational Technology*, *42*(4), 543–556. doi: 10.1111/j.1467-8535.2010.01069.x

Sandvik, M., Smørdal, O., & Østerud, S. (2012). Exploring iPads in practitioners' repertoires for language learning and literacy practices in kindergarten. *Nordic Journal of Digital Literacy*, *7*(03), 204–221. Retrieved from https://www.idunn.no/dk/2012/03/exploring_ipads_in_practitioners_repertoires_for_language_?mode=author_info_ID_G1855218601&skipDecorating=true

Schiariti, V., Mâsse, L. C., Cieza, A., Klassen, A. F., Sauve, K., Armstrong, R., & O'Donnell, M. (2014). Toward the Development of the International Classification of Functioning Core Sets for Children With Cerebral Palsy A Global Expert Survey. *Journal of Child Neurology*, *29*(5), 582–591. doi: 10.1177/0883073813475481

Schuele, C. & Boudreau, D. (2008). Phonological awareness intervention: beyond the basics. *Language, Speech & Hearing Services in Schools*. *39*, 3–20. doi: 10.1044/0161-1461

Schwan, S., & Riempp, R. (2004). The cognitive benefits of interactive videos: Learning to tie nautical knots. *Learning and Instruction*, *14*(3), 293–305. doi: 10.1016/j.learninstruc.2004.06.005

Schwartz, I. S., Carta, J. J., & Grant, S. (1996). Examining the use of recommended language intervention practices in early childhood special education classrooms. *Topics in Early Childhood Special Education*, *16*(2), 251–272. doi: 10.1177/027112149601600208

Sekaran, U. (1983). Methodological and theoretical issues and advancements in cross-cultural research. *Journal of International Business Studies, 14*(2), 61–73. doi: 10.1057/palgrave.jibs.8490519

Shane, H. (2011). Mobile Devices and Communication Apps: Current Trends and Future Directions. Retrieved from https://www.youtube.com/watch?v=3F3Ud6BFtAQ

Sharples, M., Taylor, J., & Vavoula, G. (2005). Towards a theory of mobile learning. *Proceedings of mLearn 2005*. Retrieved from http://www.mlearn.org.za/CD/papers/Sharples-%20Theory%20of%20Mobile.pdf.

Shifrin, D., Brown, A., Hill, D., Jana, L., & Flinn, S. K. (2015). Growing up digital: Media research symposium. *American Academy of Pediatrics, 1*, 2015. Retrieved from https://www.aap.org/en-us/Documents/digital_media_symposium_proceedings.pdf

Shipstead, Z., Redick, T. S., & Engle, R. W. (2012). Is working memory training effective? *Psychological Bulletin*, *138*(4), 628–654. doi: 10.1037/a0027473

Shively, K. (2014). Digital Progressive Learning Environments for Elementary Children. *Curriculum and Teaching Dialogue*, *16*(1-2), 141–156.

Sigafoos, J., Lancioni, G. E., O'Reilly, M. F., Achmadi, D., Stevens, M., Roche, L., et al. (2013). Teaching two boys with autism spectrum disorders to request the continuation of toy play using an iPad®-based speech-generating device. *Research in Autism Spectrum Disorders*, *7*, 923–930. doi: 10.1016/j.rasd.2013.04.002

Silverman, D. (2013). *Doing Qualitative Research: A Practical Handbook.* Los Angeles, SAGE Publications.

Smeets, D. J., van Dijken, M. J., & Bus, A. G. (2014). Using electronic storybooks to support word learning in children with severe language impairments. *Journal of learning disabilities*, *47*(5), 435–449. doi: 10.1177/0022219412467069

Smith-Lock, K. M., Leitão, S., Lambert, L. and Nickels, L. (2013), Effective intervention for expressive grammar in children with specific language impairment. *International Journal of Language & Communication Disorders*, *48*(3), 265–282. doi: 10.1111/1460-6984.12003

Smith-Lock, K. M., Leitão, S., Prior, P., & Nickels, L. (2015). The effectiveness of two grammar treatment procedures for children with SLI: A randomized clinical trial. *Language, Speech, and Hearing Services in Schools*, *46*(4), 312–324. doi: 10.1044/2015_LSHSS-14-0041

Snow, C. E. (1989). Understanding social interaction and language acquisition; sentences are not enough. In M. H. Bornstein, & J.S. Bruner, (Eds.), *Interaction in human development.* (pp. 83–103). Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

Snowling, M. J., & Hulme, C. (2012). Interventions for children's language and literacy difficulties. *International Journal of Language & Communication Disorders*, *47*(1), 27–34. doi: 10.1111/j.1460-6984.2011.00081.x

Snyder, L. E., Dabasinskas, C., & O'Connor, E. (2002). An information processing perspective on language impairment in children: Looking at both sides of the coin. *Topics in Language Disorders*, *22*(3), 1–14.

Sorden, S. D. (2005). A cognitive approach to instructional design for multimedia learning. *Informing Science: International Journal of an Emerging Transdiscipline, 8*, 263–279. Retrieved from http://frimoth.com/EDAD536-Sum2011/halliday/avoiding%20unproductive%20multimedia%20instructional%20practices.pdf

Stark, B. C., & Warburton, E. A. (2016). Improved language in chronic aphasia after self-delivered iPad speech therapy. *Neuropsychological rehabilitation*, 1–14. doi: 10.1080/09602011/2016.1146150

Stoop, I., & Harrison, E., (2012). Classification of Surveys. In L. Gideon (Ed.), *Handbook of Survey Methodology for the Social Sciences*. (pp. 7–22). New York, NY: Springer.

Squires, D., & Preece, J. (1999). Predicting quality in educational software: Evaluating for learning, usability and the synergy between them. *Interacting with computers*, *11*(5), 467–483. doi: 10.1016/S0953-5438(98)00063-0

Sutton, M. (2014), Tactus Therapy Retrieved from http://tactustherapy.com/blog/

Sweeney, S. (2010). Five Criteria for evaluating and integrating simple technology resources in speech and language interventions. Retrieved from http://www.scribd.com/doc/44503715/Fives-Booklet

Sweller, J. (1994). Cognitive load theory, learning difficulty, and instructional design. *Learning and instruction, 4*(4), 295–312. doi: 10.1016/S0959-4752(01)00018-4

Takacs, Z. K., Swart, E. K., & Bus, A. G. (2015). Benefits and Pitfalls of Multimedia and Interactive Features in Technology-Enhanced Storybooks A Meta-Analysis. *Review of Educational Research*. *85*(4) 698–739. doi: 10.3102/0034654314566989

Taylor, J., Sharples, M., O'Malley, C., Vavoula, G., & Waycott, J. (2006). Towards a task model for mobile learning: A dialectical approach. *International Journal of Learning Technology, 2*(2-3), 138–158. doi: 10.1504/IJLT.2006.010616

Thatcher, A., & Mooney, G. (2008). Managing Social Activity and Participation in Large Classes with Mobile Phone Technology. *International Journal of Interactive Mobile Technologies (iJIM), 2*(3), 41–51. Retrieved from file:///Users/demo/Downloads/Managing_Social_Activity_and_Participation_in_Larg .pdf

Therrien, M.C.S. & Light, J. (2016): Using the iPad to facilitate interaction between preschool children who use AAC and their peers, *Augmentative and Alternative Communication, 32*(3) 163–174. doi: 10.1080/07434618.2016.1205133

Thomas, E., & Magilvy, J. K. (2011). Qualitative rigor or research validity in qualitative research. *Journal for Specialists in Pediatric Nursing, 16*(2), 151–155. doi: 10.1111/j.1744-6155.2011.00283.x

Tomasello, M., & Farrar, M. J. (1986). Joint attention and early language. *Child development*, 1454-1463. *57*(6), 1454–1463. doi: 10.2307/1130423

Torkildsen, J. V. K., Dailey, N. S., Aguilar, J. M., Gómez, R., & Plante, E. (2013). Exemplar variability facilitates rapid learning of an otherwise unlearnable grammar by individuals with language-based learning disability. *Journal of Speech, Language, and Hearing Research, 56*(2), 618–629. doi:10.1044/1092-4388(2012/11-0125

Tosh, R., Arnott, W., & Scarinci, N. (2016). Parent- implemented home therapy programmes for speech and language: a systematic review. *International Journal of Language & Communication Disorders*. doi: 10.1111/1460-6984.12280

Traxler, J. (2009). Learning in a mobile age. *International Journal of Mobile and Blended Learning (IJMBL)*, *1*(1), 1–12. doi: 10.4018/jmbl.2009010101

Turkstra, L. S., Norman, R., Whyte, J., Dijkers, M. P., & Hart, T. (2016). Knowing What We're Doing: Why Specification of Treatment Methods Is Critical for Evidence-Based Practice in Speech-Language Pathology. *American Journal of Speech-Language Pathology*, *25*(2), 164–171. doi: 10.1044/2015_AJSLP-15-0060

Tversky, B., Morrison, J. B., & Betrancourt, M. (2002). Animation: can it facilitate? *International Journal of Human-Computer Studies*, *57*(4), 247–262. doi: 10.1006/ijhc.2002.1017

Vaala, S., & Takeuchi, L. (2012). *Parent co-reading survey: Co-reading with children on iPads: Parents' perceptions and practices*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop. Retrieved from http://www.joanganzcooneycenter.org/wp-content/uploads/2012/11/jgcc_ereader_parentsurvey_quickreport.pdf

van Kleeck, A. (1982). The emergence of linguistic awareness: A cognitive framework. *Merrill-Palmer Quarterly 28*(2). 237–265. Retrieved from https://www.researchgate.net/profile/Anne_Van_Kleeck2/publication/232596541_The_emergence_of_linguistic_awareness_A_cognitive_framework/links/570ff3cd08ae19b186938706.pdf

van Kleeck, A., Schwarz, A. L., Fey, M., Kaiser, A., Miller, J., & Weitzman, E. (2010). Should we use telegraphic or grammatical input in the early stages of language development with children who have language impairments? A meta-analysis of the research and expert opinion. *American Journal of Speech-Language Pathology*, *19*(1), 3-2. doi: 10.1044/1058-0360(2009/08-0075)

Virnes, M., Kärnä, E., & Vellonen, V. (2015). Review of Research on Children with Autism Spectrum Disorder and the Use of Technology. *Journal of Special Education Technology*, *30*(1), 13–27. doi: 10.1177/016264341503000102

Vissers, C., Koolen, S., Hermans, D., Scheper, A., & Knoors, H. (2015). Executive functioning in preschoolers with specific language impairment. *Frontiers in Psychology*, *6*. 1–8. doi: 10.3389/fpsyg.2015.01574

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wake, M., Tobin, S., Levickis, P., Gold, L., Ukoumunne, O. C., Zens, N., ... & Reilly, S. (2013). Randomized trial of a population-based, home-delivered intervention for preschool language delay. *Pediatrics*, *132*(4), e895-e904. doi: 10.1542/peds.2012-3878

Wakefield, L., & Schaber, T. (2012). APP-titude: Use the evidence to choose a treatment app. *The ASHA Leader. 17*, 38–39. doi: 10.1044/leader.APP.17092012.38

Walker, H. (2011). Evaluating the effectiveness of apps for mobile devices. *Journal of Special Education Technology, 26*(4), 59–63.

Wang, F., & Reeves, T. C. (2003). Why do teachers need to use technology in their classrooms? Issues, problems, and solutions. *Computers in the Schools, 20*(4), 49–65. doi: 10.1300/J025v20n04_5

Warren, S. F., & Yoder, P. J. (1994). Communication and language intervention: Why a constructivist approach is insufficient. *The Journal of Special Education*, *28*(3), 248–258. doi: 10.1177/002246699402800302

Weng, P. L., & Taber-Doughty, T. (2015). Developing an App Evaluation Rubric for Practitioners in Special Education. *Journal of Special Education Technology*, *30*(1). doi: 10.1177/016264341503000104

Whyte, J. (2014). Contributions of treatment theory and enablement theory to rehabilitation research and practice. *Archives of Physical Medicine and Rehabilitation*, *95*(1), S17–S23. doi: 10.1016/j.apmr.2013.02.029

Wilkinson, D., & Birmingham, P. (2003). *Using Research instruments: A Guide for Researchers*. London and New York, Routledge, Taylor & Francis Group.

Wolfe, D., & Heilmann, J. (2010) Simplified and expanded input in a focused stimulation program for a child with expressive language delay (ELD**)** *Child Language Teaching and Therapy***,** *26*(3**)** 335–346. doi: 10.1177/0265659010369286

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry*, *17*(2), 89–100. doi: 10.1111/j.1469-7610.1976.tb00381.x

Wouters, P., van Nimwegen, C., van Oostendorp, H. & van der Spek, E.D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology*, *105*(2), 249–265. doi: 10.1037/a/0031311

Yelland, N. (2011). Reconceptualising play and learning in the lives of young children. *Australasian Journal of Early Childhood*, 36(2), 4–12. Retrieved from http://www.earlychildhoodaustralia.org.au/wp-content/uploads/2014/06/AJEC1102.pdf

Yoder, P. J., Kaiser, A. P., & Alpert, C. L. (1991). An Exploratory Study of the Interaction between Language Teaching Methods and Child Characteristics. *Journal of Speech, Language, and Hearing Research*, *34*(1), 155–167. doi: 10.1044/jshr.3401.155

Zack, E., Gerhardstein, P., Meltzoff, A. N., & Barr, R. (2013). 15- month- olds' transfer of learning between touch screen and real- world displays: language cues and cognitive loads. *Scandinavian Journal of Psychology*, *54*(1), 20–25. doi: 10.1111/sjop.12001

Zipoli, R. P., & Kennedy, M. (2005). Evidence-Based Practice Among Speech-Language Pathologists Attitudes, Utilization, and Barriers. *American Journal of Speech-Language Pathology*, *14*(3), 208–220. doi: 10.1044/1058-0360(2005/021

APPENDICES

Appendix A

SPEECH PATHOLOGY & AUDIOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Features of iPad apps for Language Intervention

1. INFORMATION AND CONSENT

My name is Nikki Heyman and I am a Masters Student in the department of Speech Pathology & Audiology at the University of the Witwatersrand, South Africa. You are invited to take part in a research study in order to identify the factors that speech-language pathologists feel are important when selecting and using apps for language therapy with children.

This form describes the purpose, benefits and risk of the study. The study comprises two parts, an online survey and a follow up interview with a small group of participants. You can complete the online survey and not take part in the interview. You may withdraw from the survey at any time and you may also refuse to answer any question.

The aims of the study are to:
Identify criteria that speech pathologists feel are important when selecting and/or using apps for language intervention with children.

Who is being asked to participate?
- Speech Language Pathologists (SLPs) in six predominantly English speaking countries (South Africa, United Kingdom, Australia, New Zealand, Canada and the United States of America).
- SLPs who use iPad apps in their intervention with children with language impairment.

What choice do you have?
Participation in this research survey is entirely voluntary and information will be kept confidential. Once you have completed the survey, you will be invited to participate in a follow up Skype/FaceTime interview. If you agree to the interview your name and personal details will be kept confidential.

What will you be asked to do?
If you agree to participate, you will be asked to complete the survey. The survey should take no longer than 10 minutes to complete. Following completion of the survey, you will be invited to participate in a follow up online interview in order to obtain further insights into some of the issues raised from the surveys. If you agree to participate in the interview, which will last approximately 20 minutes, arrangements will be made at a time that is suitable for you. With your permission, the interview will be recorded and notes will be taken. To ensure your confidentiality your name and personal details will not be disclosed. It will not be possible to trace responses back to any individuals. The recording, notes and surveys will be kept until no longer needed for producing publications, thereafter it will be destroyed.

Risks
There are no risks associated with participating in this study. If you decide to complete the survey, you

will not be identified. There are not right or wrong answers and this is not about testing speech-language pathologists about their clinical knowledge.

Benefits

There are no direct benefits to you but it is possible that by completing the survey you will assist therapists in identifying features of apps that are important for intervention. You will also be contributing to research where there are gaps in the field.

The ethics for conducting this research was approved unconditionally by the Wits University Human Research Ethics Committee (Medical), Protocol Number: M150873. If you have understood the content of this information sheet, please click 'next' to start the survey. If there is anything you do not understand or you have any questions please contact me or my supervisor.

Nikki Heyman: nikkiheyman@icon.co.za Victor De Andrade: victor.deandrade@wits.ac.za

Features of iPad apps for Language Intervention

2. GENERAL

*** 1. In what language do you provide therapy most often?**

- English
- Spanish
- Afrikaans
- Portuguese
- Other (please specify)

*** 2. Do you use iPad apps in therapy with children?**

- Yes
- No

*** 3. Have you ever developed an app or contributed to the development of an app for speech/language therapy?**

- Yes
- No

SPEECH PATHOLOGY & AUDIOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Features of iPad apps for Language Intervention

3. GENERAL

4. Please state your professional level qualification

- ○ Bachelors degree
- ○ Honors degree
- ○ Masters degree
- ○ Masters and Clinical Fellowship (CFY)
- ○ Masters and Certificate of Clinical Competence (CCC)
- ○ Doctorate

5. In what kind of setting do you work? (Check all that apply)

- ☐ Preschool
- ☐ Elementary/Primary School
- ☐ Clinic
- ☐ High School
- ☐ Special Needs School
- ☐ Hospital (Acute/Rehabilitation)
- ☐ Home Health
- ☐ Private Practice
- ☐ University
- ☐ Other (please specify)

Features of iPad apps for Language Intervention

4. GENERAL

6. How long have you worked as a Speech Language Pathologist (SLP) or Speech Language Therapist (SLT)?

- ○ Less than 1 year
- ○ 1 - 5 years
- ○ 6 - 9 years
- ○ 10 - 15 years
- ○ More than 15 years

SPEECH PATHOLOGY & AUDIOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Features of iPad apps for Language Intervention

5. App USE

7. How often do you use iPad apps in therapy?

- ○ At least 3 times a day
- ○ Daily
- ○ Two to three times a week
- ○ Once a week
- ○ Less than once a week

8. Please describe how you use apps in therapy?

9. In a typical week which of the following types of apps do you use in therapy? (Check all that apply)

- [ ] Apps designed specifically for language therapy
- [ ] Phonological Awareness
- [ ] Educational apps (e.g. reading, spelling)
- [ ] Articulation apps
- [ ] Alternative Augmentative Communication (AAC) apps
- [ ] Productivity apps (e.g. calendars, document readers, notes)
- [ ] Games (e.g puzzle games, arcade games, board games, strategy games)
- [ ] Books
- [ ] Medical (apps that are focused on medical education)
- [ ] Photographic and video apps (camera, photo-editing, photo sharing, movie)
- [ ] Music apps
- [ ] Reference (e.g. dictionary, general research)
- [ ] Social Networking
- [ ] Other (please specify)

10. Do you re-purpose apps designed for other purposes to target a specific language skill?

- ( ) Yes
- ( ) No

11. Please can you elaborate on how you re-purpose apps.

Features of iPad apps for Language Intervention

6. CONTENT AND INSTRUCTION

12. Do you think that using iPad apps for language intervention helps you to reflect on your therapy (what you are targeting, how you are targeting it)?

- ◯ Yes
- ◯ No
- ◯ I don't know

Comment

13. How important is it to you that a language app is based on evidence - based practice?

Not at all important	Slightly important	Moderately important	Very important	Extremely important
◯	◯	◯	◯	◯

14. Which of the following features are important to you in an app when working with children with language difficulties? (Select all that apply)

- [ ] Auditory model
- [ ] Written model
- [ ] Auditory and written model
- [ ] Hint
- [ ] Visual representation
- [ ] Word/picture highlighting before making selection
- [ ] App does not allow response before question is completed
- [ ] Repeat instructions
- [ ] Multiple examples for practice
- [ ] Different developmental or difficulty levels
- [ ] Multiple Learning modalities (i.e different ways to target the same skill)
- [ ] Interactivity with the app
- [ ] Other (please specify)

15. When using an app to target language skills, which one of the following features do you feel is *most* effective in engaging the user?

- ○ Animation
- ○ Video modelling
- ○ Photographic representation
- ○ Graphic representation
- ○ Color illustration
- ○ Other (please specify)

16. Do you think it is important to have a reward incentive within an app?

- ○ Yes
- ○ No
- ○ Don't know

17. What type of incentive do you prefer?

- [ ] One reward game
- [ ] Choice of reward games
- [ ] Token incentive
- [ ] Star Chart
- [ ] Puzzle piece
- [ ] Other (please specify)

18. If the child makes an error would you like the feedback to be immediate?

- ◯ Yes
- ◯ No
- ◯ Don't know

19. If the child makes an error when responding, what type of response would you prefer to get? (Check all that apply)

- [ ] Sound to reflect incorrect response (e.g. buzz or ting)
- [ ] Visual display to reflect incorrect response (e.g. cross)
- [ ] Corrective audio feedback with suggestions
- [ ] Option to try again
- [ ] Reduce level of difficulty of task
- [ ] Proceed to the next item
- [ ] Other (please specify)

SPEECH PATHOLOGY & AUDIOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Features of iPad apps for Language Intervention

7. DESIGN FEATURES

20. Which of the following design features do you think are important in a language app? (Select all that apply)

- [ ] Child friendly theme
- [ ] Adjustable screen background
- [ ] Text on/ Text off feature
- [ ] Record feature
- [ ] Text to speech
- [ ] Control speed of progression
- [ ] App tutorial
- [ ] Different user profiles
- [ ] Report generation
- [ ] Save progress
- [ ] Background noise option
- [ ] Delay stimulus
- [ ] Activity selection
- [ ] Item selection
- [ ] More than one difficulty level
- [ ] Choice of the number of foils
- [ ] Other (please specify)

21. How important is the narrator's voice in the app to you?

Not at all important	Slightly important	Moderately important	Very important	Extremely important
○	○	○	○	○

22. Do you think that it is preferable to have different voices or accents available on an app?

- ◯ Yes
- ◯ No
- ◯ Don't know

23. Would you be prepared to pay an additional $5 (U.S) to include*all* of these features in an app if they were not included?
Animation, voice recording, multiple user profiles, reward game, ability to select specific language structures (e.g specific verbs), Report, different accents/voices, different language, additional content, additional activities within the app

- ◯ Yes
- ◯ No

Features of iPad apps for Language Intervention

8. EDUCATION

24. Which of the following sources do you use to get information about apps? (Check all that apply)

- [ ] Blogs
- [ ] Developer sites
- [ ] Social networks
- [ ] Word of mouth
- [ ] App review sites
- [ ] iTunes
- [ ] Other (please specify)

25. Do you trial a 'lite version of an app before purchasing the full paid version?

- ( ) Yes
- ( ) No
- ( ) Sometimes

26. What are some of the reasons that you have adopted the use of apps in therapy? (Check all that apply)

- [ ] Engagement of students
- [ ] More relevant for students
- [ ] Variety of materials
- [ ] Portability of device
- [ ] Variety of activities
- [ ] Reward games
- [ ] Student motivation
- [ ] Cost saving
- [ ] Time saved on preparation
- [ ] Ease of use
- [ ] Other therapists are using them
- [ ] Provided by employer
- [ ] Other (please specify)

27. Have you received any formal training on iPad implementation for therapy?

- ( ) Yes
- ( ) No

28. What type of training did you receive? (Check all that apply)

- [ ] Not Applicable
- [ ] In service training/professional development training
- [ ] Workshop
- [ ] Online Course
- [ ] Other (please specify)

29. Would you like to receive further training using iPads for therapy?

- ◯ Yes
- ◯ No
- ◯ Don't know

30. How would you like to receive this training?

- ☐ Not Applicable
- ☐ Professional Workshop
- ☐ Webinar
- ☐ Accredited e-learning
- ☐ Other (please specify)

Features of iPad apps for Language Intervention

9. DEMOGRAPHIC INFORMATION

31. Please identify your current geographical location from the list below

- ◯ Urban
- ◯ Suburban
- ◯ Rural

*** 32. In what country do you currently reside?**

- ◯ Australia
- ◯ Canada
- ◯ New Zealand
- ◯ South Africa
- ◯ United Kingdom
- ◯ United States
- ◯ Other (please specify)

33. Which city or town do you live in?

34. What is your age?

- ◯ Younger than 20
- ◯ 21 - 29
- ◯ 30 - 39
- ◯ 40 -49
- ◯ 50 - 59
- ◯ 60 or older

Features of iPad apps for Language Intervention

10. Follow Up Interview Consent

You are invited to participate in a follow up online interview in order for me to obtain further insights from the survey. Only a few participants will be contacted for the follow up interview, but if you agree to participate in the online interview your details will be kept confidential.

*** 35. I consent to a follow up online interview in order for the researcher to obtain additional detail from this survey.**

- ○ Yes
- ○ No

SPEECH PATHOLOGY & AUDIOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Features of iPad apps for Language Intervention

11. Consent information: Follow Up Interview

36. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason

- ◯ Yes

37. Please enter your contact information in order for me to contact you for a follow up interview

Name	
Address	
Address 2	
City/Town	
State/Prov/County	
ZIP/Postal Code	
Country	
Email Address	
Phone Number	

38. I grant permission for the researcher to use anonymous quotes from my interview.

- ◯ Yes
- ◯ No

39. I agree to the interview being audio recorded

- ◯ Yes
- ◯ No

SPEECH PATHOLOGY & AUDIOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Features of iPad apps for Language Intervention

12. Thank you!

Thank you very much for your participation. Your time and effort are greatly appreciated

Appendix B

Semi-Structured Interview

Thank you for your assistance. In order to obtain a more nuanced understanding of the factors that therapists feel are important when using apps for language therapy, I would like to explore some of the factors that have emerged from the survey.

I would like to remind you that that this conversation is being recorded but your responses will be kept anonymous.

1. Please tell me about your work setting and the population that you work with?
2. How do you view your role as the therapist when using apps for language intervention?
3. Do you think that your approach to intervention has changed in any way by using apps in therapy? If so, how?
4. The data from the survey showed that apps designed specifically for language therapy are being used most frequently followed by articulation apps. Why do you think that therapists are favouring the use of language apps?
5. Most respondents felt that using an app helped them reflect on their therapy. Does using an app affect the way you plan your therapy session or your goals? If so, how?
6. When using an app for language intervention, what aspects of the app do you feel contribute to therapy?
7. When using an app for language intervention, which aspects of an app do you feel interfere or impede language learning?

8. The majority of respondents felt that when a child made an error, they would like the child to have the option to try again (as oppose to corrective audio feedback, reduced level of difficulty, proceed to the next item, sound or visual display to reflect incorrect response). Why do you think the option to try again was the most frequently selected option?

9. The majority of respondents felt that Evidence Based Practice was moderately to very important when selecting an app. Why do you think therapists have placed EBP in this range (i.e. moderately/very important)? What sources do you rely on for Evidence when it comes to using apps?

10. Respondents felt that the narrator's voice and accent were moderately or very important. What elements of the narrator's voice do you feel are important when using an app? Why do you feel this is important?

11. If you were to receive further training regarding using apps for therapy, what aspects would you like to know more about? What specific training would you like to receive?

12. Is there anything more you would like to add?

Appendix C

R14/49 Ms Nikki Heyman

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M150873

NAME: (Principal Investigator)	Ms Nikki Heyman
DEPARTMENT:	Speech Therapy and Audiology Survey Monkey
PROJECT TITLE:	The Identification of Features in Language Applications for Ipad for Speech Therapy with Children
DATE CONSIDERED:	28/08/2015
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Victor de Andrade
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	09/12/2015

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Secretary in Room 10004, 10th floor, Senate House, University.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**.

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix D

SPEECH PATHOLOGY & AUDIOLOGY
THE SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT (SHCD)

Private Bag 3, Wits, 2050 • Tel: 011 717 4577 • Fax: 011 717 4572 • E-mail: sppa.SHCD@witsac.za

5 August 2015

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

Dear Sir/Madam

My name is Nikki Heyman, and I am a Speech Pathology student at the University of the Witwatersrand in Johannesburg, South Africa. I am conducting an international study for my Master's dissertation. This involves the identification of features that speech pathologists deem important when using apps for language therapy in children. This study will be conducted under the supervision of Dr Victor de Andrade and Andrea Fourie.

In order to obtain this information I have created a survey to obtain the clinical perspectives of therapists who use apps. I am hereby seeking your consent to distribute my online survey to the members of your organisation in order to obtain participants for this project.

I have provided you with a copy of my ethics certificate (medical) and protocol number in order to conduct this research.

If you require any further information or you have any concerns regarding the nature of my research, please do not hesitate to contact me.

Email: nikkiheyman@icon.co.za Cell: +27 (0) 82 447 1579

Alternatively you may contact my supervisor Victor De Andrade at

Victor.DeAndrade@wits.ac.za or Andrea Fourie at Andrea.Fourie@wits.ac.za

Thank you for your time and consideration in this matter.

Yours sincerely,

Nikki Heyman

Appendix E

	P2	P4	P5	P7	P8	P11	P12	P16
Tool		Something extra to fall back on	I use it as a tool. I do the same thing. Don't give it as busy-work, just like using toys in therapy	I am absolutely the therapist	I use it as a tool		App is just the material, more attractive exciting way, addition to therapy tool bag	Really exciting tool I can bring in to help me
Reinforcement	Reward using language app							The app doesn't work until you get it right so that's their reinforcement. If they get it wrong, I like it that they can keep trying till they get it right & get reinforced
Resource	Another way to target. You can't think up that many things	Gives me more flexibility, approach has not really changed, planning time is tight, quick & easy, so many types of language goals. Variability in language	Definitely adds to therapy	We're busy, so it's helpful, time saving, things I would miss, get in a rut	More flexibility, additional activity that is on a screen, therapists stretched for time	Useful resource. Saved having huge bags. More options. It is instant. Helps planning therapy, balance between being interesting and a toy	Repertoire of activities, depending on case, can make our life easier	I'm not stuck with the cards I've got. I am open to any picture I need of anything

	P2	**P4**	**P5**	**P7**	**P8**	**P11**	**P12**	**P16**
Games						Toca Boca, Our Story App	Toca Boca, My PlayHome	Angry Birds, Toca Boca
Engagement	Behaviour programme, fun	Fun, engaging, drawn in, interested, eager to do it	Things that they are interested in, motivation	Back up if I am losing attention & need to re-engage, so engaging, motivating for kids	iPad seen as reward, really supports gaining their attention, artificial attention grabbing, not direct interaction per se	Want children to engage, its fun, contributes by making it more fun, it's a treat	More options for choosing activities for those who are difficult to engage, incredibly motivating	So strongly motivating, joy on children's faces, opens doors for children, less boring, brings back focus
Levels of difficulty		Break goals down into discrete pieces				Alter the level of difficulty	Help with producing levelled instructions, listening in background noise	
Therapist role	I judge, give positive feedback, prompting, I am right there, aware of student, monitor, correct wrong answers			Want kids to be successful, provide learning opportunity	Traditional direct therapy with me facilitating & working towards specific objectives, Lots of starting & stopping. You are getting	Showing people what you can get out of an app, facilitating and supporting, providing feedback	Doesn't take over from me being clinician. Active in the engagement. Choose most appropriate activity driven by the client's needs &	Very important that I have my goal & developmental level. I stay the same but I have more interesting activities. My role is to

					it, that wasn't quite right. Have a think. You are doing therapy alongside it. I can adjust the complexity of my language		presentation. Teaching kids to self monitor important. Want kids to have success, provide teaching opportunities. Success keeps engagement. Keep in mind clinical knowledge & own problem solving. Don't hand too much stuff open to the apps	encourage & support even if they didn't get it. Active facilitation depending on developmental level. I am very involved, I watch the kids all the time
Education	Parents do not put them on it & walk away!					Showing people what you can get out of the app		
Training		Options for accessibility for kids with handicaps, way I could use them more effectively	The most effective features in apps, what to look for in an app. Features that are more effective with children, what is a no-no	Training on implementation, hard to interact. Maintaining the interaction. How to choose evidence based apps	Wider knowledge of how to use them appropriately. Extend the use beyond therapy but appropriately. Facilitate	How to customise, there's so much more I could get out of it, I could probably get more than I currently do	Use apps to the maximum ability that they could be used	How to use them in therapy, finding out from other therapists how do you manage this, where do you struggle?

	P2	**P4**	**P5**	**P7**	**P8**	**P11**	**P12**	**P16**
Familiarity with app			Review it yourself and make sure it's working exactly on the things you would want to work on and correcting the way you would				Need to allocate time to explore the app, see what it can do	
Information		Descriptions are nice	Parents - Don't give it as busy-work. Sit with your child. It is not a good idea if they are working on it by themselves		I can't be researching through the app store, that does my head in.			
Screen Time	Concerns about screen time		Use fun apps for language intervention. You can get in there…there's a way to fix it	Educate parents on how to use apps together with children like any other plaything. I have a lot of apps but I don't want that to be what therapy is. I think about that frequently	Stop staring at screens. Stare at my face. Artificial attention grabbing, Family education, it's got its place but it's about balance	It's still screen-time, it's just getting balance		I try not to just use that mode. Is it okay to just be using the iPad? I have this resistance that I can't use this my whole session. It's got to be balanced

	P2	**P4**	**P5**	**P7**	**P8**	**P11**	**P12**	**P16**
Therapist use/adaptation		Play based using an iPad			Visual timetable, video-instant playback, I turn the volume right down, Favour the ones that don't have language on them	iPad is a useful resource, story making app with Lego building and send to the teacher, instant rewards, show parents, guided access, not in a group you can't, barrier games, photos, sequence building, you can turn the volume off in an app	Open ended apps, generic apps that can do a variety of things, play based can get more realistic language, turn the volume down-I produce the voice rather than the app	Use the apps in different ways - vocab, language, speech, reinforcement, Use it interspersed with other activity
Self Reflection	Ideas how to provide therapy, structure & target, app as teacher	Design helps me figure out ways to break goal down into more discrete pieces		Try to be very purposeful, not more than any other activities. Good at coming up with lists	Self-reflection is often a therapy aim, need to be able to pause	Look at all the things I did in the session, not just the app	Structure helps you reflect on child's production. Recognising when children can't replicate learning from app to other situations. Keep broader clinical awareness & knowledge around all activities	I question myself, it makes me think of their level - not in terms of the app but where's he at? I keep using it as a guide

	P2	**P4**	**P5**	**P7**	**P8**	**P11**	**P12**	**P16**
Interaction	Talking about it together. We're both interacting with it	I use it in an interactive way, involved with apps	Keep the kids talking while they are using the app, use the language, make it a shared activity, it contributes because of the interactiveness. Fake interactive stuff	Collaborative effort between me & kids, all about engagement and togetherness you don't give it to the kid and walk away	3-way relationship between apps, me & the child. We can comment together, I want the dynamic of working with the child. Concern about one way interaction with screen	Take turns on a board game but not on the iPad because they are desperate to have it	Need to maintain social engagement	Need to watch for eye contact
Context of use	Parents- do not put them on it & walk away	Used in the right way in the right context	Tiny tap games for homework but I made those! It's more play based using an iPad. That's how I like to do therapy…play based	Language development, play based, social stories, Can I do that without the screen?	Time restraints are a part of it. Pressures of society			
Approach to intervention	More streamlined, more therapy in my sessions, more production	Data collection helps take a quick look where child is. Snap shot of progress	Everyone loves the ones that are more structured. Maybe they are less play based	Approach doesn't change. It's just the modality. I use play-based apps more	Traditional therapy approach, families are asking for it, changing a little bit, My style of approach is the same. I have my set target. Objective is to work on self	I am still doing the same things, just in a different way	Make some things easier to achieve in the clinic room, so specific it hones you into the goal, helps stay on task & goal, structure around language targets. Play based get more	Helps structure my session, It's made me enjoy my therapy more so it's more fun for the children, Simulated therapy room. It just opens more, language is so

					correction		realistic language rather than very structured. Aware of what you are using it for & who. Clinical awareness around all activities	much more diverse than just the activities in our room. We are looking for more language activities
Modelling		I know verbal modelling is EB that works						
EBP	Designed with teaching strategies I know, description about the app, how they came up with it, colleagues, review sites, philosophy of company, SLP design	Limited evidence on apps, but it's EB interventions that I use with the child. I know verbal modelling is EB. I'm looking at what I know to work for me in a therapy setting	It is a tool and use the same strategies that are evidence based	Whatever the app developers put in their description, personal experience, see that it works with a kid or it doesn't, credentials of app developers, what I know about therapy, see if it is building, scaffolding in it, looks like other materials I've used	Boils down to own experience, case studies, therapists talk about apps, correlation with EB programmes, what works stuff, rated or approved by professionals, word of mouth			

	P2	**P4**	**P5**	**P7**	**P8**	**P11**	**P12**	**P16**
Repetition	Concrete, repetitive		Apps that have a repetitive routine relatable to real life		Quite repetitive & rigid so they can achieve it in that app but not in another. Multiple examples			It is a therapy in a way if it was used regularly. They would learn without us being there. Maybe not as effectively
Feedback				We want kids to be successful		Feedback so that they know they have made an error		
Generalisation	Look and see is it generalising?	Jump through hoops to get through it; so setup			Consolidation, different format or context, useful for generalising & consolidating. It facilitates generalisation		Transfer from that learning to other things. Can't replicate app learning to natural environment	
Pace	Apps that are quick	Sometimes they hit the wrong buttons so it's nice to do that one over. Because you are teaching. Pause time and try again		Apps that make me put in info before I can get into the app	Most apps go at the pace that you are selecting. They don't move on & on. I can take the pace that's needed		Ability to pause & stop gives more processing time	

	P2	**P4**	**P5**	**P7**	**P8**	**P11**	**P12**	**P16**
Error Response	Goes back		Sometimes the child accidentally hits the button, I'd rather the child have the correct answer than guess again	Getting things wrong is the learning opportunity		Sometimes they don't get it on the right bit and they think they've got it wrong		
Progress tracking		Collect data constantly				Score things and see what they did	Give direct feedback as to how the child did rather than an impression, so specific	
Voice and Accent	Real natural kid voice	Kids want to listen to someone that sounds more like them, accent neutral. It could be more engaging to have a different accent	Robotic voices can be easier for autism. I stay away from fake sounding voices. I don’t feel like the kids ever cared	Option for an American accent. Natural sounding voices, get the inflection, hear co-articulation, not flat, prosody, clear sounding. Important for apraxia	Accent, they hear enough American stuff, but the children are able to understand. The vocabulary as well	Annoying if it's very American accent, mirror the child's voice, sometimes kids like the American voice better. I am making assumptions, Autism prefer robotic voices	Very rarely Australian voice. Will pick UK over US if there is choice. Find a way around it if it was a good quality app	Some of those American apps - whew those voices, the tone, pitch, rate is often way too fast, Accent should be more neutral

	P2	**P4**	**P5**	**P7**	**P8**	**P11**	**P12**	**P16**
Positive Features	Guided access, repetition, goes back, keep language the same, ease of use, non-readers, fun graphics, American voice. You can't think up so many things	Data collection helps, graphics- some things pull them in more. Animation & real pictures. Moving draws them in more, multiple players, anything that does data for me, customizable features, descriptions are nice, link to specific curriculum goals, changing backgrounds	Visual and auditory, photographs or very cartoony, turn on/off features, multiple touch input more effective because it allows more interaction	Good at coming up with lists, I would get in a rut & always do the same ones, visually attractive, price	Nice & visual, sound effects, do stuff, lovely graphics, ability to pause	Pop a balloon throw a basketball in a hoop is more fun than a sticker. Can alter level of difficulty, add rhymes that you need, guided access, funny noises	Visuals provide support, scoring function worthy place, microphone - self evaluation, video pops up and goes away, ability to pause & stop, ability to add photos	Visual tool, autism - predictable, same & consistent, real photographs make it more real, having an end point
Negative Features	Too much reading, strange voice, confusing interface	Too many breaks, difficult to set up, music can make some kids crazy, over-stimulated with some apps	Get involved in the apps & don't want to talk to you any more. Less sound effects, background music, colours less contrastive or something. Different children need different things	Takes me a long time to get into it	I'm not fond of them when they are in American, weird terminology	Interactive stories very distracting, bells and whistles, get stuck on that and we lose what we are doing, game apps can have adverts, you can't share it like a game	Can get too involved, restrictive- don't do what I want them to do. Reading - juggling the words around things. App becomes everything. Big noises, negative responses	Apps that go on & on for as long as you want to play. Some of the sounds on the apps - loud sounds, voices, scary images